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OUR FRONT COVER

WISHING YOU A HAPPY AND PROSPEROUS NEW YEAR!

Little Cindy Bertram of Boise, Idaho, steps into the role of Miss Farmerette for 1951 and extends a willing hand to help many new homesteaders to clear their newly acquired lands of sagebrush. The tool which she proposes to use is somewhat obsolete where modern-day farming is concerned, but the apparent eagerness with which she approaches the huge task overshadows the inadequacy of the scythe. Photo by Stan Rasmussen, Region 1 Photographer.

30 YEARS AGO IN THE ERA

RECLAMATION IN IDAHO

Mr. R. E. Shepherd of the Western States Reclamation Association, writing in the New West Magazine, speaks in the following happy vein concerning the Reclamation Service:

"To my mind the United States Reclamation Service is better fitted to undertake the work of water conservation than the State or private enterprise, and any plan which did not include this valuable department of the Government would be quite unwise. The work of the United States Reclamation Service has resulted in the development of large areas of desert and semiarid land in a most satisfactory manner. The construction work of the Reclamation Service is certainly a model of excellence. Its research work and study in the problems of land reclamation have been of great value to all engaged in western development. It has already successfully built many large dams in various parts of the West. I know of none that have not in practice come up to the expectations of those dependent upon them."

(From page 31, January 1921 issue of the RECLAMATION RECORD, predecessor of the RECLAMATION ERA.)

RECLAMATION PLACE NAMES IN THIS ISSUE

REPORT ON THE 19th ANNUAL NRA CONVENTION

Forty resolutions, many of them relating to operations of the Bureau of Reclamation, were introduced during the final session of the 3-day Nineteenth Annual Convention of the National Reclamation Association at Spokane, Wash., Wednesday, November 15 through Friday, November 17, 1950, one of the most heavily attended conventions in recent years.

Among the important speakers were Senator Guy Cordon of Oregon who spoke on "Sound Reclamation Development," Senator Arthur V. Watkins of Utah whose talk was entitled, "Local Ownership and Control Versus Federalization," Maj. Gen. Lewis A. Pick, Chief, Corps of Army Engineers who talked on "Our Resources and the Future of America," and Representative Wayne Aspinall of Colorado who spoke on "Reclamation—Yesterday, Today, and Tomorrow."

Dillard B. Lasseter, administrator of the Farmer's Home Administration, spoke on "Credit Needs for the Small Farms in Reclamation Areas," H. P. Singleton, superintendent of the irrigation-experiment station at Prosser, Wash., spoke on "Agricultural Research in the Columbia Basin Project," Roger Fleming, secretary-treasurer of the American Farm Bureau Federation, titled his speech, "A Look Ahead," Harold T. Nelson, Director of the Bureau of Reclamation's Region 1 with headquarters at Boise, Idaho, told of "The Challenge of the Columbia River Basin," John Geoffrey Will, secretary and general counsel for the Upper Colorado River Commission, Grand Junction, Colo., spoke on "The Upper Colorado River Commission," and Kennard Cheadle, former chief counsel of the Bureau of Reclamation spoke on "Basin-wide Reclamation Development."

Commissioner of Reclamation Michael W. Straus discussed "Reclamation's Programs and Problems," on Thursday which was water users' day, presided over by Val Kuska, agricultural development agent of the Chicago, Burlington and Quincy Railroad Co., Omaha, Nebr.

A "grass roots" discussion was held following Commissioner Straus' speech lead by the following: Cecil C. Clark, farmer and horticultural leader on a small farmer-operated ditch and also on the Roza division, Yakima project, Wapato, Wash.; George M. Skoegard, president of the Fresno irrigation district, Fresno, Calif.; R. D. Searles, president of the Salt River Valley Water Users Association, Scottsdale, Ariz.; Royden G. Girling, president of the North Fork water conservation district, Lazear, Colo.; N. B. Phillips, manager of the El Paso County water improvement district, El Paso, Tex.; H. C. Gardiner of Anaconda, Mont., manager of the Mount Haggin Land & Livestock Co., and E. O. Daggett, manager of the farmers irrigation district, Scottsbluff, Nebr.

During the course of Commissioner Straus' speech, in which he gave a report of the accomplishments of the Bureau of Reclamation and summarized the present program with regard to the international situation, he pointed out and clarified several basic Reclamation policies.

Regarding soil conservation, he said, "You are hearing a lot about watershed control and soil conservation these days. I see no reason for any Reclamationists to be critical of watershed control or soil conservation. They should support them both to the limit—the Bureau certainly does. We do because we believe they are necessary and good for the West, but we also do for more selfish reasons. If there is not better watershed protection and soil conservation practice, the good reservoirs we build to save and hold water lose space to silt faster than necessary. Reclamation wants that soil and silt held on the watershed and not running into our reservoirs and it is just as simple and selfish as that. But the way to meet that problem is to speed up soil conservation and watershed protection practice and not to hold back the pacemaker, which is Reclamation."

"The same approach should be made in meeting the viewpoint of the fish, recreation, and wildlife groups," he said, explaining that "there is rarely

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HIGHBALL for HUNGRY HORSE

by JACK CRISWELL

Hungry Horse Project, Montana
Region 1 (headquarters at Boise, Idaho)

TALL TIMBERS TOPPLED by ball and chain. *Photo by the Author.*

You probably have heard about the fellow who went to the circus for the first time, and seeing a giraffe eating leaves off tree branches 20 feet in the air, said unbelievingly, "Shucks, there ain't no sech animal."

Writers, photographers, contractors, and engineers express much the same reaction when they first see the amazing "highball" clearing method pioneered this year in the 24,000-acre Hungry Horse reservoir area in northwestern Montana. One writer for a national magazine declared, "I heard about it and didn't believe it. Now, I see it, but I still don't believe it. It can't be done."

Actually, the new land-clearing method, which uses teams of powerful Diesel tractors towing up to 2,000 feet of heavy wire rope with a gigantic 8-foot diameter steel ball fastened into the line midway between the two tractors, has been so fantastically successful that the system may well revolutionize the clearing industry.

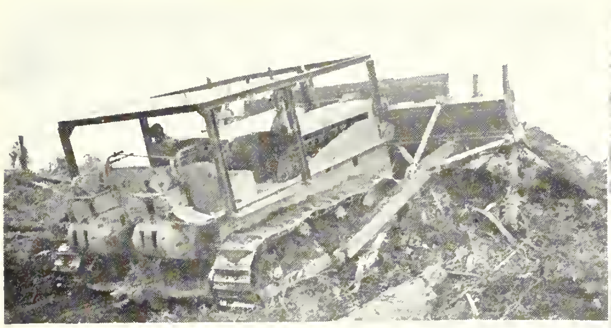
Product of the imagination and engineering know-how of the two major clearing contractors working in the big Bureau of Reclamation reservoir, the new land-clearing method has been aptly named "operation highball," not only because of the 4½ ton steel balls used, but also because the mechanized scheme clears timbered land at a rate rivaling the legendary feats of Paul Bunyan.

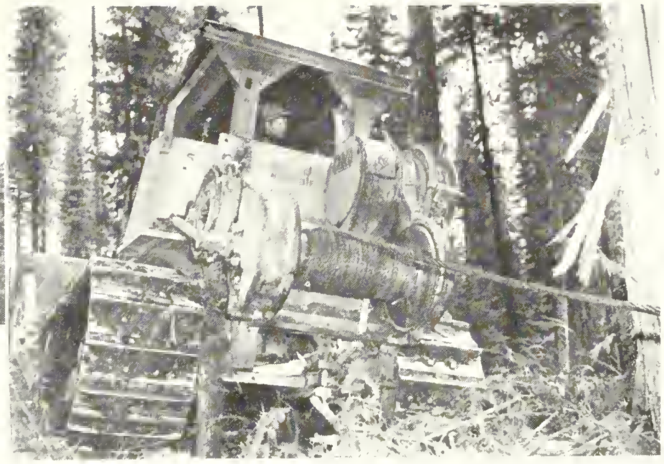
Although the revolutionary idea was tried for the first time just last May, the almost unbelievable speed and efficiency achieved with the new snagging method have already attracted widespread interest among logging and clearing contractors. The unique and spectacular nature of the "highball" snagging operation has also attracted great public attention, and as a result it has been filmed by a national newsreel company, and has been written up in a great many of the national construction magazines and trade publications. Popular Mechanics magazine, for one, carried a comprehensive article in the August 1950 issue, and also used a painting of the tractor, cable, and ball set-up on the front cover.

The men who developed the revolutionary clearing method and are using it to snag down the timber on the steep mountain slopes and valley floor of the Flathead River's south fork in northwestern Montana are S. L. "Red" Wixson of Wixson and Crowe, Inc., and John Trisdale of J. H. Trisdale, Inc., both of Redding, Calif.

Basically, the "highball" clearing idea is a refinement on a very effective mechanized clearing method developed and used last year by the two contractors, in which pairs of Diesel tractors were used to drag up to 400 feet of 2-inch wire cable through the timbered areas, snagging down all of the trees, snags, and brush caught in the loop of the cable.

Working largely in burned over areas last year, the contractors found the cable snagging method





SIAMESE CAT, above, clears about 1 acre of debris per hour. The pull of heavy timber is so great on tractor (at right), operator must drop dozer blade on stump to prevent skidding. ***Photos by A. E. McCloud, Region 1.***

so efficient that they were able to complete about 95 percent of their joint contract for clearing 7,210 acres of land before winter stopped operations. However, land being cleared under new contracts awarded last December—6,840 acres to Wixson and Crowe on a bid of $2,446,850 and 7,855 acres to Trisdale on a bid of $2,484,360—is mostly in areas from which merchantable timber has been removed by logging contractors. Recognizing that the cable would hang up on the stumps left by the loggers, Wixson and Trisdale put their imaginations to work and came up with the idea of using the 8-foot diameter steel balls to keep the the cable high enough above the ground to prevent snagging on stumps.

Effectiveness of the big steel balls in increasing the efficiency and speed of clearing operations has surpassed the most optimistic estimates of the contractors. Not only are the balls accomplishing their primary purpose—elimination of cable hang-ups on stumps—but the additional leverage applied by catching the trees several feet above the ground instead of at the ground level has speeded snagging operations to an amazing extent. Working on fairly level ground under ideal conditions, one pair of tractors pulling one ball actually snagged down in 4 hours all of the trees on a heavily timbered area of nearly 200 acres. Average daily production for one pair of tractors and one ball working under varying conditions, including steep hillsides, marshy ground, etc., has been close to 100 acres per 10-hour shift.

As a result of the speed of the "highball" snagging method, the two contractors were able to complete approximately 60 percent of their new contracts in just over 7 months of work, and it is anticipated that the entire clearing job will be finished by December 1951—more than a year ahead of the scheduled completion date.

Although the "highball" clearing method was an entirely new and untried idea, Wixson and Trisdale had enough faith in their brain child to gamble a small fortune on its success. Their combined bids were nearly $2,000,000 under the first bids submitted for the clearing work. The original bids were rejected because they were too much above the engineer's estimate. As soon as the contracts were awarded to them, the two contractors moved swiftly to translate their revolutionary idea into the new type of clearing equipment. Five steel balls were fabricated in halves out of $\frac{3}{4}$-inch boilerplate steel by the Consolidated Western Co. of San Francisco. Installation of 6-inch steel shafts in Timken roller bearings and final welding of the 8-foot diameter, $4\frac{1}{2}$-ton steel spheres were done in the Redding, Calif., shops of the two clearing contractors, and the balls were then trucked to the reservoir area.

First experiments in use of the new equipment indicated that the fastest and most efficient set-up consisted of one ball pulled by a pair of tractors. In making a snagging "pull" the two tractor operators bulldoze their way through the forest on approximately parallel paths 100 feet or more apart—the distance between the tractors varying with the type of terrain and the size of the trees to be snagged down. In light going, the tractors move through the timber snagging down the trees caught in the loop of cable as they progress. How-

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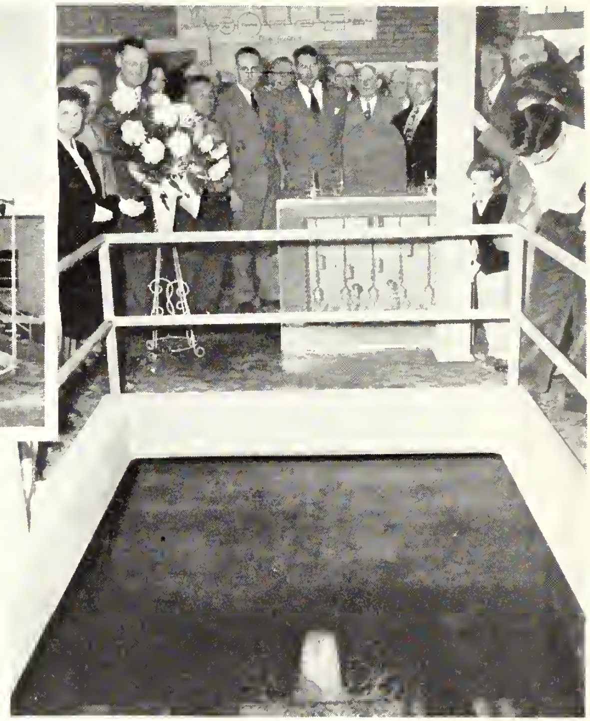


'TWAS A GREAT DAY for Lewiston Orchards when the domestic water treatment plant (above) went into operation. Reclamation and Lewiston Orchards Irrigation District officials inspect filter bed at right. *Photos by Stan Rasmussen, Region 1 photographer.*

"Drinking" Water

by H. Q. CLARK, Chief Clerk, Lewiston Orchards Project, Idaho, Region 1 (headquarters at Boise, Idaho)

WHEN HARRY ISAMAN, PRESIDENT OF THE LEWISTON ORCHARDS IRRIGATION DISTRICT, moved the remote-control level which sent raw water gushing into the domestic filters, he opened a new era for residents of the suburban area near Lewiston, Idaho. For over 40 years the water users had endured the hardships accompanying drinking water which varied in color from a light gray in the winter to a chocolate brown during the seasons of heavy rain or runoff.

"Too thick to drink, too thin to plow," people said of the water when it became really dark. Housewives took their washing to the nearby town of Lewiston, Idaho, and husbands toted home precious gallons of drinking water to their families. The State of Idaho's Public Health Department condemned the Orchard's water as unfit for domestic use.

The first domestic water system constructed by the Bureau of Reclamation in the West as a primary purpose of a project, will change all that. The system, which went into operation on October 22, 1950, is complete with modern filtration plant and pipelines to serve the 1,500 homes and 4,000 residents of the 3,500-acre irrigation district. Water users celebrated the occasion with a ceremony and open house at the filter plant, at which the project was officially dedicated by H. T. Nelson, regional director for the Bureau in the Pacific Northwest.

Designed to serve an ultimate population of 6,000 with pure, sparkling drinking water, the treatment plant has a capacity of 1,300,000 gallons per day. First, lime and alum are added to the water. Then in an outside circular clariflocculator, 55 feet in diameter, most of the suspended particles settle out. Four rapid sand filters within the plant complete the process of removing foreign matter. The water is then chlorinated and ammoniated, piped out to a 1,500,000-gallon capacity, concrete-covered, reservoir, and is ready for delivery to Lewiston Orchard's homes.

Not all of the water used in the district, however, is filtered and treated. Two completely separate pipe systems are installed, one to carry the filtered domestic water, the other to carry raw water for irrigating 3,800 acres of land which in the past has suffered serious water supply shortages. Each tract or homesite has two connections, one for domestic water, the other for irrigation. Because of the steep terrain and small size of most of the ownerships, irrigation is done almost en-

tirely by sprinklers. A minimum 50-pound pressure is maintained in the irrigation mains.

Newcomers to the area are quick to see the advantages of the new system. Four hundred new homes have been built in the irrigation district since 1948, according to Walter Hereth, district manager. Most of these are on small tracts of one or two acres each, for part-time farmers or city folks who feel they need more elbow room.

The works of the present district were first built by private interests in 1906. Wooden flumes were used for diversion, and wood pipe was laid for the distribution system. The same water was used for domestic as well as irrigation purposes.

The system gradually deteriorated, losses ranging from 12 to 85 percent from section to section of the system. Pressures were inadequate for satisfactory delivery of domestic water to many homes, and, in addition, portions of farm units were left dry, due to an inadequate water supply. After tremendous effort by local people, the Congress in 1946 approved a Bureau of Reclamation plan for reconstructing all the facilities, including the replacement of the diversion works and flumes with modern concrete structures, and the installation of separate irrigation and domestic distribution systems to replace the old deteriorated wood pipelines.

Work was begun in September 1947, and initial water delivery was made in October 1950. The project cost $2,500,000, which will be entirely repaid by the water users over a 50-year period. As such, it is one of the few new projects that can be entirely repaid by the water users, others having to depend on power revenues or nonreimbursable costs. Upon completion of the project, it will be turned over to the irrigation district to operate, in conformance with Bureau policy.

Regional Director Nelson was enthusiastic about the completion of the project when he addressed the thousand people gathered at the plant for the dedication ceremonies. He said the Bureau of Reclamation did not look upon the celebration as a mere gathering of a few people around a new water-treatment plant.

"To us," Mr. Nelson said, "this ceremony is symbolic of the steady progress that the Pacific Northwest is making toward assuring full, orderly development of its land and water resources. It is symbolic of the strengthening of the Nation through the building of prosperous, virile American communities."

Orchards residents are enthusiastic about their new kind of drinking water. At the dedication ceremony, Board Chairman Isaman proposed that the first glassful from each kitchen tap be drunk to the health of Construction Engineer W. L. Karrer, who supervised the work. And each glassful drunk from that time on will be a toast to the health of the Lewiston Orchards people, too! THE END.

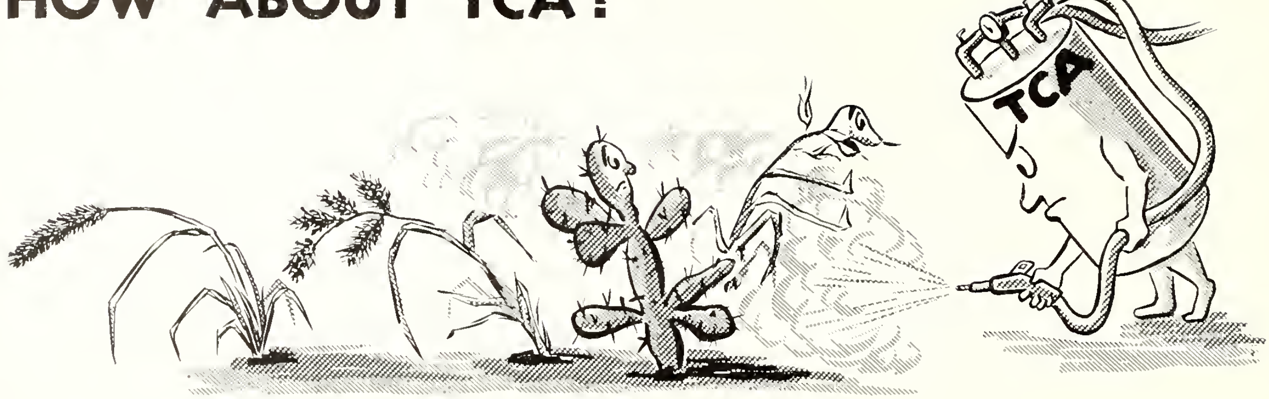
GONE ARE THE DAYS when inadequate water supplies caused dry spots on Lewiston Orchards farms. Wilbert Tressler and his son Lawrence stand in the luxuriant lettuce growth on the John Chemanti farm, insured against drought by the Bureau of Reclamation's renovation of the irrigation system. *Photo by Stan Rasmussen, Region 1 photographer.*

Savage Receives New Honors

John Lucian Savage, "the billion-dollar engineer," also known as the "water resources engineer to the world" and the recipient of perhaps more honors in his field than any living engineer, has again been honored. This time, he was awarded the Interior Gold Medal for Distinguished Service by Secretary of the Interior Oscar L. Chapman on September 15, 1950. On November 29, President Truman appointed him a member of an 11-man advisory committee on the Point 4 program. Chairman of the committee is Nelson Rockefeller.

For the complete story of Mr. Savage's amazing career see "Reclamation's Hall of Fame—John Lucian Savage," p. 91, RECLAMATION ERA, May 1950.

HOW ABOUT TCA?



A New Weed Killer for Grasses

by ROBERT B. BALCOM, Chief Agronomist, Branch of Operation and Maintenance

A year or two ago very few people had heard of TCA. Nearly every one has heard of 2,4-D, which takes care of many broadleaved plants. But what to do about the grassy weeds?

Federal, State, and commercial weed control researchers heard the plea of farmers, irrigation officials, and others to find something that would kill superfluous grass and not sterilize the soil for a long period.

They have tested hundreds of chemical formulas, but one of the most promising is TCA whose grass-killing properties were first demonstrated by DuPont's Pest Control Laboratories. TCA is the abbreviation for trichloroacetic acid. Several chemical companies manufacture the herbicide and you can buy sodium TCA at most stores selling weed control supplies. Most people add water to the sodium salt and use TCA as a spray.

TCA VERSUS JOHNSON GRASS, below. Foreground was treated. Background of lush grass, as yet untouched by TCA, dramatically illustrates the contrast between treated and untreated stands. *Photo by Harry Meyers, Region 3 photographer.*

Although the new herbicide is quite selective, affecting grasses more than most broadleaved plants, it is not as selective as 2,4-D, which has little effect on plants in the grass family, including cereals.

All irrigation projects are plagued with problems caused by annual and perennial grasses on crop land or ditchbanks. Foxtail, squirreltail, cheatgrass, wild oats, and numerous so-called watergrass are examples of annual grasses. While they are pestiferous and cause crop reductions and maintenance problems you can control them easier than perennials. Some of the worst perennial offenders are the reed grasses, called carrizo cane, in the Southwest, and a wheat grass called quack grass, quitch grass, and couch grass. Several others come in for their share of unprintable adjectives, but perhaps the most troublesome of all is Johnson grass.

On some of the projects in the Southwest, Johnson grass is the worst weed, barring none. Therefore it is only natural that Fred Arle, agronomist for the Bureau of Plant Industry, Soils, and Agricultural Engineering, in charge of the weed research project at Phoenix, Ariz., has devoted considerable of his efforts to Johnson grass control. This is a part of the BPI's weed research program conducted cooperatively with the Bureau of Reclamation.

Many of the State college experiment stations also have been testing TCA on grasses with various results, but agree that it *is* effective on Johnson grass. Drs. Alden S. Crafts and W. H. Harvey of

the California Station at Davis report that experiments indicate that a spray treatment which is followed by rains that wash the chemical into the soil may be most effective. Also, there is some indication that after spraying, the chemical is translocated into the underground rhizomes (creeping underground stems) of Johnson grass. They have found TCA effective on perennial grasses at rates of from 20 to 100 pounds per acre, depending upon the species of grasses. Most research workers recommend the higher rates for Johnson grass.

The California station also reports that spray applications at rates around 5 pounds per acre seem promising for controlling watergrass (an annual) in cotton and sugar beets, but had not conducted sufficient tests to make general recommendations. Other stations also have reported good success when low rates were used for annual grass control in certain crops, and the method merits further testing and research.

Kansas State College, in its circular 255, entitled, "Control of Obnoxious Perennial Grasses with the Trichloroacetates," summarizes its work as follows:

1. Trichloroacetates can be used to control noxious perennial grasses when applied at rates of 80 to 150 pounds per acre.

2. Annual grasses are controlled readily by dosages ranging from 20 to 60 pounds per acre applied as a foliage spray.

3. Treatment of the soil with TCA will prevent the growth of grasses arising from seed in the soil. The chemical, therefore, holds some promise for control of weedy grasses by pre-emergence treatment.

4. Prickly pear cactus plants have been eliminated completely by spraying with a solution of ½ pound of TCA to 1 gallon of water.

5. Shallow rooted grasses can be controlled most successfully by applying TCA to the soil after removal of the top growth. Grasses with deep root systems are controlled more successfully by foilage applications.

6. The moisture content of the soil has an important influence upon the effectiveness of soil applications of TCA. It also affects the duration of soil sterility.

In the fall of 1949, the weed crews on the Yuma project, in cooperation with C. W. Bowser of the regional office and Mr. Arle, used about 3,000 pounds of TCA at a rate of 120 pounds of 90 percent material applied as a coarse spray on Johnson grass and carrizo cane. The Johnson grass was reduced by 90 to 95 percent in sections of ditch where the banks were not disturbed throughout the season. Only about 40 to 50 percent eradication resulted where the canal was dredged or where the grass was burned during January or February. TCA retarded the growth of the carrizo cane until late summer, but did not reduce the number of plants. A. E. Simmons, superintendent of the Palo Verde district, applied 1,500 pounds at the rate of about 90 pounds of TCA per acre. Regrowth occurred, mostly from shallow rhizomes, but the Johnson grass was greatly thinned out.

An interesting sidelight on the use of TCA was the discovery made by Oscar Fudge, of the Imperial irrigation district. When he added TCA to 2,4-D the combination was effective in the control of cattails. On one area he obtained 100 percent kill with one application. This method has since been tested by the BPI weed-research stations and in the Bureau's regions with varying results. However, in most cases they have found that TCA plus 2,4-D gave better results than 2,4-D alone. More testing is needed on this method before general recommendations can be given.

Coming back to Mr. Arle's work with Johnson grass in the Salt River Valley, he found that around 100 pounds of TCA per acre resulted in almost 100 percent kills. To be on the safe side, some weed leaders are recommending 120 pounds per acre of the product as it is obtained from the

(Please turn to page 18)

A GOOD TEAM for getting rid of cattails—TCA and 2,4-D, pictured at right. ***Drawing by Graphics Section, Washington, D. C.***

SPOTLIGHT ON MINIDOKA FAMILY

Old-timers and new settlers on Bureau of Reclamation projects should get many a reminiscent chuckle or sigh from the story of the Roland Powers family which was selected by the Ladies' Home Journal in October 1950 for feature treatment in their How America Lives series.

"Homesteaders 1950" starts out with the following paragraph:

The yearning of men and women for land of their own is as old as history. This irresistible drive impelled generations of earlier Americans to leave comfortable surroundings for the hazardous trek westward. The right of pioneers to stake claims to public lands was first legally recognized when Abraham Lincoln signed the Homestead Law in 1862. The spirit of that law remains in effect today, and the urge to blaze fresh paths in the wilderness is still strong. As our frontiers have closed, new homesteads have been carved out of vast areas reclaimed from the West's arid deserts. Since the war, the Interior Department's Bureau of Reclamation has opened more thousands of irrigated acres to veterans chosen by lot, with 3 years of proved farm experience (after the age of 15) and with assets of $3,000. The lucky ones have 5 years to prove their patent to the land. Typical of the thousands of recent homesteaders engaged in creating a home and a livelihood from the desert sagebrush are Edith and Roland Powers, of Idaho. This is their story.

The story of the Powers family tells the familiar tale of a young couple trying to get a start on an irrigated farm. How the Powers are proving claim to 160 acres of Idaho's Magic Valley land includes the disappointment of Roland Powers when his name was not selected at the drawing, his elation when one of the chosen applicants dropped out and he was given another chance, the second disappointment when the land he thought would be his turned out to be another's and his downright despair when he was given a rocky, unbroken tract. The hand-me-down furniture from the WRA encampment, the 2½-mile walk to the mail box (later shortened to a ½ mile) the trip to the 5- and 10-cent store, the jackrabbits, rattlesnakes, ditch mud, and blowing dust are all there. His first experience at irrigation is well worth quoting:

The only magic in the Magic Valley is the water. To reach the Powers land, it must flow 27 miles from the point where the canal leaves the Snake River. That first hopeful spring when the liquid magic gurgled down the canals, Rolly thought he was ready. He had painstakingly "set" his best fields according to verbal instructions. But words cannot assess in advance what a given flow of water will do in a new ditch on an unmeasured grade.

The water nearly washed them out. At 4 a. m. Rolly was in the fields, checking the head ditch, the stilling basin, and the dozens of corrugates, or small trenches supposed to distribute the water evenly through the planted fields. As he stood there, his heart pounding wildly, a center ditch washed out. Furiously Rolly shoveled to patch it, then dashed inside to gulp his breakfast. When he came out, the trench was spilling over again.

Thus it went all day, seven separate washouts, the final one at 11 that night. "When the water is running," Rolly learned, "you can't turn your back even to eat. It'll wash everything away unless you're right there packing a shovel."

When Rolly dragged himself home that night, his face was blacker than coal and he ached in every muscle. He was not only dead beat, he was disgusted and ready to call it quits. "I'm no farmer," he told Edith. Listening while he berated himself, Edith realized it was up to her "to turn Rolly around."

His hands were so swollen and cracked from "handling the water" that he couldn't bend them. Edith tenderly coated on Vaseline and wrapped the puffed fingers with torn sheets. Lovingly she soothed his weary anguish, insisting that he not blame himself for inexperience, that everyone had a lot to learn. Presently Rolly fell asleep in her arms. Next morning when he awoke, full of good cheer and fresh resolve, Edith knew she had accomplished "what a wife must do—make her husband understand she has not lost faith in him."

The Ladies' Home Journal gave the RECLAMATION ERA permission to reprint extracts from this moving account of one of the homesteading families on a Bureau project. There is an unhappy sequel to the story behind the story, however. We learn that Richard Lauterbach, the author who wrote so understandingly of the Powers' struggles, died of polio in October. He will be well remembered by the Bureau and the people around Minidoka for his insight into the problems of homesteading and his graphic account of a typical young American family.

Here are his two concluding paragraphs:

The two men who know most about the homesteaders' prospects, Chenowith and Sandberg, [*Vern Chenowith and Sandy Sandberg of the Farmers Home Administration.*—Ed.] *have faith that the Powerses will get patent to their land in a year or two. Thus far Rolly has had no trouble meeting requirements of the Homestead and Reclamation Laws. His crop this year should gross about $7,000, above average. With another loan from Sandberg (this one under a recently approved low-interest 40-Year Farm Development Program), he hopes to "get out from under a bit." To do this, he plans sprinklers instead of ditches for certain fields, more leveling, erection of fences, and the purchase of six milk cows. Gradually, Rolly will shift his farm's emphasis to dairying so that when the GI school income terminates next year the family will have another source of revenue.*

After the water is shut off this year, Rolly intends to put a solid foundation under their hand-me-down house, insulate it, install the furnace and bathroom, cover the rugless floors, and, in general, pay more attention to living. "We're got to make an investment in comforts now," Rolly says. "Gosh, you gotta live. You only live once. I don't know how we're gonna do it, but we'll sure try."

And Edith, her eyes warmly reassuring him, adds, "That's all anyone can ask; isn't it?"

THE END.

TAKING INVENTORY, below. ON THE JOB, at lower right. *Photo of ex-school teacher Powers below by Stan Rasmussen, right photo by Phil Merritt, both of Region 1.*

CUT THE COSTS

by G. S. ELLSWORTH, Assistant to the Commissioner for Management Planning

Plagued by the same increasing costs that concern the woeful housewife and affect the balance sheets of business, large and small, the Bureau of Reclamation is concentrating on a program of unprecedented magnitude to find ways and means of securing greater economy and efficiency in its operations—and to put them into effect.

"Reduce the costs of doing business" is the current and continuing tocsin and watchword, and every Bureau employee has been enlisted in the campaign. On every job—in every office—Bureau employees are subjecting their work and practices to hypercritical analysis and meeting with special committees of their fellow workers to discuss and decide upon changes and improvements that will cost less and accomplish more in the same or less time.

Commissioner Straus placed the problem in perspective in his remarks before Reclamation leaders during the Santa Barbara conference in July, as follows:

"[With Reclamation's growth], your responsibilities have multiplied. Where in years gone by, loose practices, procedures, or policies might have wasted 5 pennies of a nickel—by comparison, because of Reclamation's growing program, now they would waste the 20 nickels of a dollar. The public, the national, and Reclamation's own internal check-up and accountability will, inevitably, and should, without fail, increase in similar proportion. It already has."

Previously, congressional committees considering the fiscal year 1951 general appropriation bill had reflected impatient concern with the increased costs of Federal Government operations, particularly personnel costs. In the case of the Bureau of Reclamation, Senator Carl Hayden, chairman of the Interior appropriations subcommittee, agreed with Assistant Commissioner Lineweaver that the Bureau's past and continuing efforts could produce the necessary results if prosecuted vigorously, and the Senate appropriations committee contented itself with instructions to the Commissioner "to continue his examination" of personnel and organizational requirements. The committee further requested that a report be submitted "at the next session of Congress as to what has been accomplished along this line."

Arrangements for the currently intensified efforts to "reduce the costs of doing business" were crystallized at a conference in Washington during October of representatives of the Bureau's regions, branches, and offices. The meeting was sponsored by Assistant Commissioner Nelson and conducted by the Commissioner's Office of Management Planning. The conferees adopted the methods previously employed by Region 7 in pilot studies of "costs of doing business" which, briefly, provide that the work of every employee shall be analyzed and that special committees should be established to review objectively and critically all procedures, practices, and activities "to eliminate 'excesses' in our operations, and to bring staffing squarely in line with essential programed work."

The Commissioner has instructed all office heads to effect without delay any improvements or changes within their authority and to submit to him before January 1, 1951, the recommendations of their organizations for improvements or changes in Bureau operations requiring action by the Commissioner. Simultaneously, the Commissioner designated the three Assistant Commissioners as a special committee "to review all procedural changes recommended (for action by the Commissioners) to assure objective, impartial analysis and recommendation."

The program of cost reduction extends to all phases of Reclamation's activities: to operation and maintenance which directly and currently affects nearly 100,000 water users on projects in operation, to the planning and construction of new projects, and to overhead or administrative expenses wherever incurred—in Washington, Denver, regional, or project offices.

And in the words of Commissioner Straus again, "it is always in order that we frequently take stock of ourselves and our effort with our own most advantageous and intimate knowledge of Reclamation . . . and it is in order that we do so frankly and without sparing ourselves of warranted criticism."

Reclamation's people are responding—by action and deed.

The End.

Central Valley's Flood Lesson

A week before the rivers of California went on a rampage last November, Secretary of the Interior Oscar L. Chapman announced that comprehensive legislation for California water control and flood prevention had been submitted, with Presidential approval, to the Congress of the United States.

As the November 1950 flood reached its crest, and earned the title of the worst flood in California's history, Shasta Dam's Reservoir in the upper reaches of the Sacramento River in the north, and Friant Dam's Millerton Reservoir in the upper regions of the San Joaquin River near the southern end of the Central Valley, swallowed completely that part of the melted snowpack from the High Sierras, which cascaded down the mountain canyons into the reservoirs behind their waiting concrete-and-steel barriers. In fact, these two reservoirs gobbled up all the water coming their way with room to spare.

During the peak of the storm, which caused flood damage estimated at $10,000,000 in the San Joaquin Valley from Saturday, November 18, through Monday, November 20, Friant Dam stopped the entire peak of the San Joaquin flow of 45,000 cubic feet of water per second. While that amount was rushing into its reservoir, Millerton

BULWARK OF THE SOUTH—Friant Dam. *Photo by Ben Glaha, Region 2's Chief Photographer.*

BULWARK OF THE NORTH—Shasta Dam. *Photo by A. E. McCloud, now in Region 1.*

Lake, only 50 cubic feet of water per second was permitted to trickle into the river below the dam. At the end of the operation ample space remained to trap additional surplus water during the winter. Besides relieving the flood pressures from tributary streams below Friant Dam, 1951's irrigation water for the great agricultural San Joaquin Valley was saved for future use during the dry season, 123,000 acre-feet of water being added to the storage supply.

Shasta stored 118,000 additional acre-feet of water during the week. Had Shasta not been built, this water would have fed into the Sacramento River, already swollen by heavy floods from tributaries below the dam. By catching the waters in the north, Shasta saved the city of Sacramento, where the Sacramento and American Rivers meet, from even worse damage than it sustained. Although the 206,000 second-foot flow of the American River was the largest on record, the citizens of Sacramento were spared the complete devastation which would have resulted had the two rivers reached flood crest at the same time.

The water stored by Shasta will also be available for hydroelectric power, irrigation, and domestic use in the coming dry, summer season. Space still remains behind Shasta to catch additional winter floods.

The major damage caused by the floods was from tributary streams below Friant and Shasta Dams, furnishing both a demonstration and an object lesson of the worth of multiple purpose structures for control, development and integration of water in California's Central Valley.

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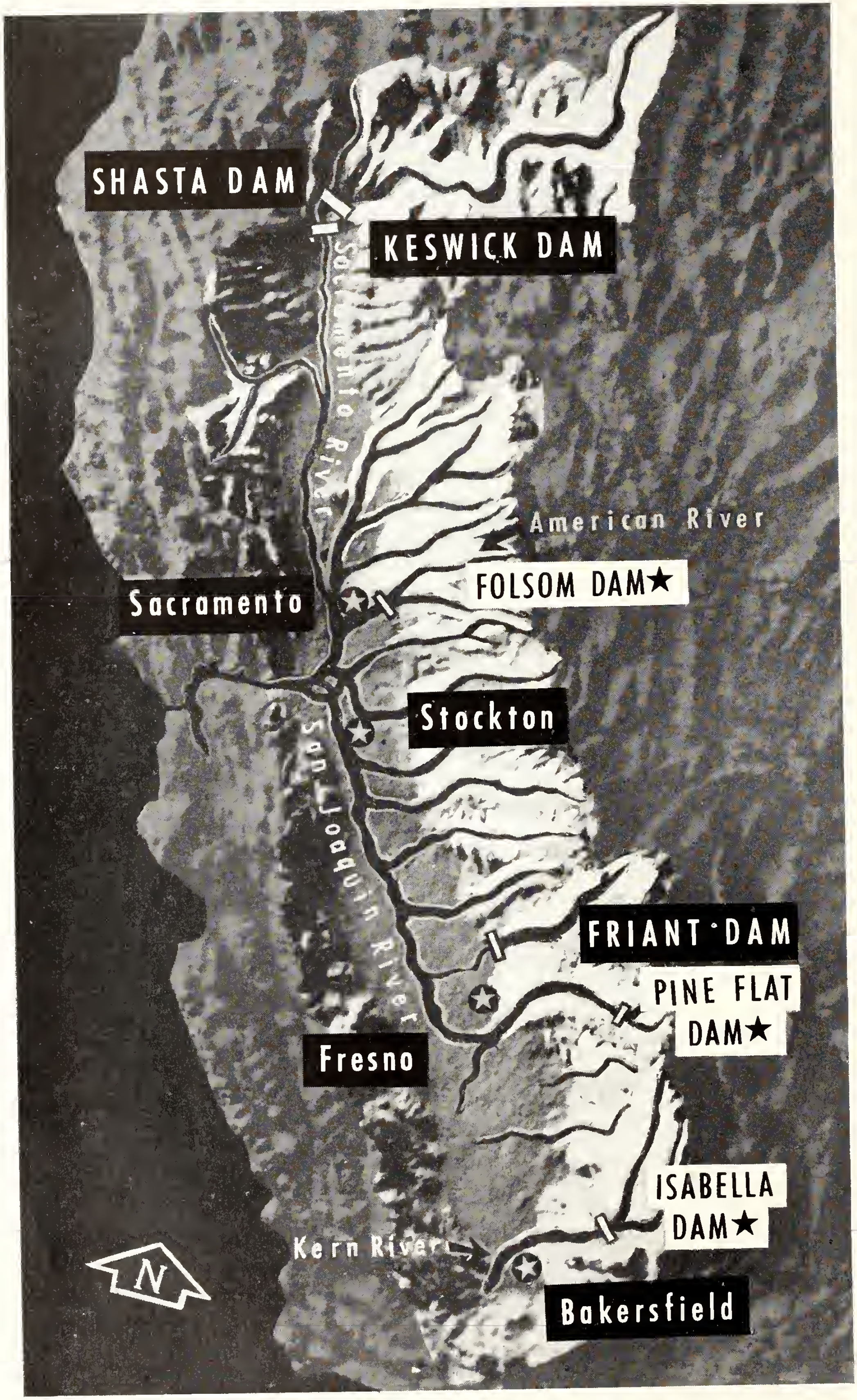
SHASTA DAM
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Sacramento River
American River
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Fresno
ISABELLA DAM★
Kern River
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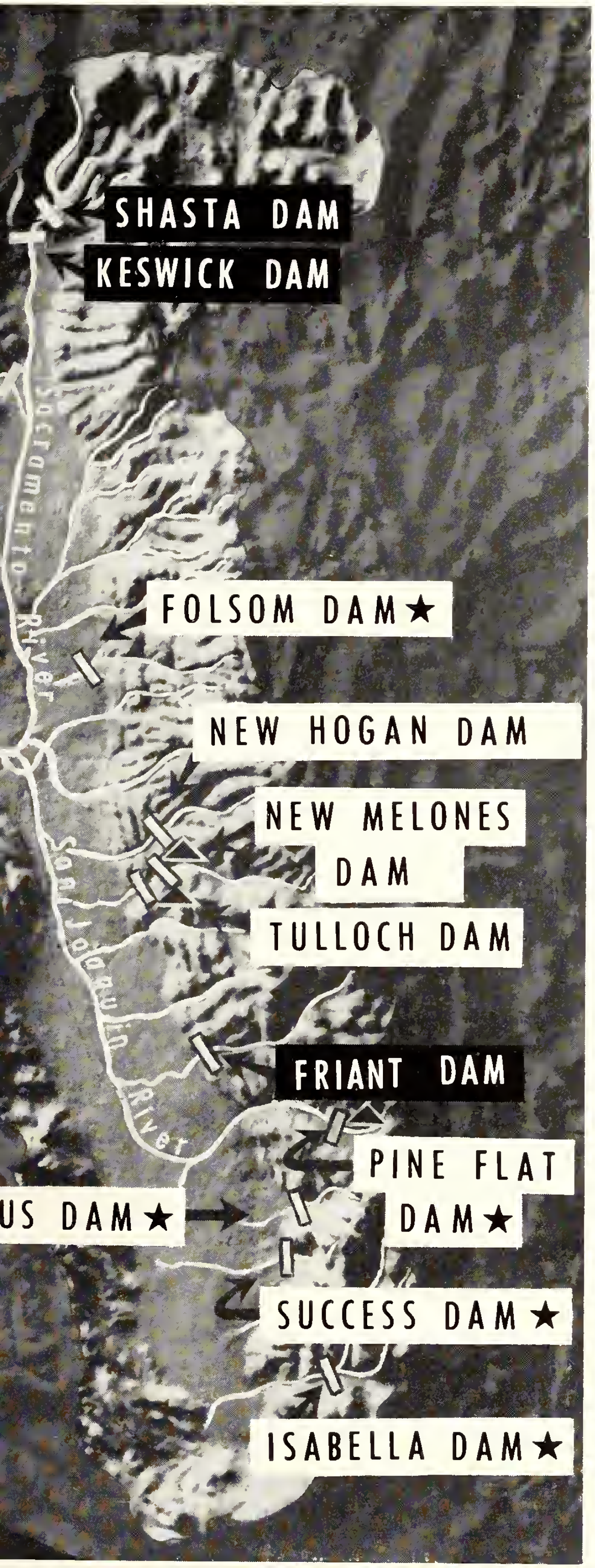


PROOF OF PROTECTION—At far left, showing how the flood waters poured into the trough of Central Valley, and how Shasta and Friant fulfilled one of their multiple purposes. PLAN FOR PROTECTION PLUS—At center, indicating the locations of the proposed structures which would work together for flood control, irrigation, municipal water supply, hydroelectric power production (power plants indicated on map by triangles), and other benefits to the people of California. Stars indicate dams to be constructed by the Corps of Engineers. ***Illustrations by the Graphic Section, Washington, D. C., office of the Bureau.***

The structures completed by the Bureau of Reclamation, Shasta Dam and Reservoir, Keswick Dam and power plant, Friant Dam and Millerton Lake, which functioned with 100-percent success during the emergency, are the first steps in the comprehensive program for California's water control, conservation, and use.

The Bureau of Reclamation's canal system for the Central Valley project, also part of this plan, sustained virtually no damage. Two structures under construction by the Army's Corps of Engineers were damaged by the flood, Folsom Dam on the American River and Pine Flat Dam on the Kings River near Fresno. Pine Flat Dam was first authorized by the Secretary of the Interior on February 10, 1940, and 10 years ago, the Bureau of Reclamation and the Interior Department sought appropriations to start its construction.

Efforts at developing a comprehensive plan for the Central Valley date back to 1873 when the Army engineers prepared a report on irrigation in the San Joaquin, Tulare, and Sacramento Valleys. Since then many reports, detailing and enlarging on the plan, have been prepared by Federal and State agencies. The Bureau of Reclamation participated in these studies almost from the time of its formation in 1902.

The so-called initial units of the over-all plan for water development within the basin were first defined in a report issued by the State in 1930 entitled, "State Water Plan." Although there have been changes in some of the engineering designs, the initial units proposed in the State report are essentially those which have been or are being built by the Bureau of Reclamation.

Senate Document 113 entitled "A Comprehensive Report on the Development of the Water and Related Resources of the Central Valley Basin for Irrigation, Power Production, and Other Beneficial Uses in California, and Comments by the State of California and Federal Agencies" was submitted to the Eighty-first Congress in August 1949.

The proposed authorizing legislation submitted

(Please turn to page 20)

THE STORY OF ENDERS DAM

Bosed on moteriol submitted by U. V. Engstrom, former construction engineer for Enders Dom, now construction engineei of Grond Loke, Colo., and Donold B. Thompson, droftsmon ond reports writer, Enders Dom project office, Nebrosko Region 7 (heodquorters ot Denver, Colo.)

At 10 a. m., on October 24, 1950, a blast of dynamite shook the earth near the town of Enders in southwestern Nebraska.

Harry D. Strunk, president of the Republican Valley Conservation Association, member of Reclamation's Hall of Fame (see p. 195, September 1949 issue of the Reclamation Era) had given the signal for the explosion, which dramatized another giant step toward security and prosperity in the Missouri River Basin.

The occasion, witnessed by about 1,500 persons, was the "plugging" of Enders Dam, the first irrigation, flood-control, silt-control dam to be started by the Bureau of Reclamation as part of the Missouri River Basin project.

While Enders Dam was under construction, Frenchman Creek flowed through a large concrete conduit. The contractors installed this huge pipe early in construction to avoid building cofferdams or other works to detour the river around the construction site. As a result, the river has become accustomed to its underground route through the dam for some time. The water entered the conduit through a temporary opening low in the base of the trash rack, or permanent intake structure.

All but the finishing touches on the dam were completed several months ago, but closing this temporary water route was delayed until October to protect the rights of downstream water users.

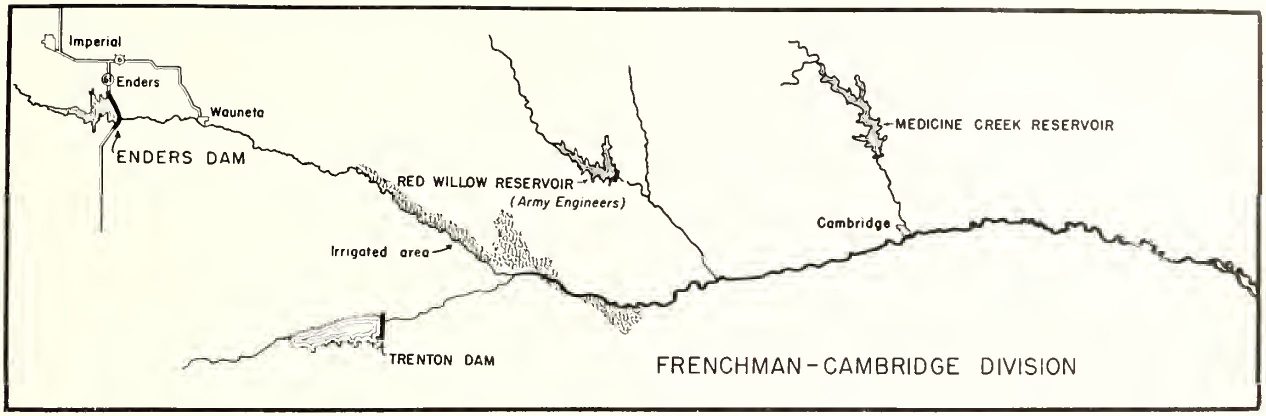
Aeriol view of Enders Dom, by L. C. Axthelm, Region 7 photogropher.

Several days before the ceremony of plugging the dam was scheduled, the flow of water from west of the dam was reduced as much as possible by shutting down outlets from reservoirs and lakes. In addition, two small dikes were erected a short distance upstream, to hold back the flow of the river, so that workmen could put the wooden concrete forms in place ready to receive the final batch of concrete which would seal the opening.

Before the rumble of the explosion had died, the first bucket of concrete was swung into position, and Harry Strunk and "Hub" Robinson (H. E. Robinson, district manager for the Bureau of Reclamation's Kansas River district) pulled the trip on the concrete bucket, releasing the first batch. An hour and a half later, Enders Dam had been "plugged."

When the water rises 40 feet higher in the reservoir, it will enter the upper part of the intake structure, shoot down into the conduit again, and resume its subway trip to the other side of the dam and its outlet works.

Thus was a cycle completed. Construction began on Enders Dam on March 26, 1947. On May 29, 1947, Harry Strunk also presided at the dam's dedication ceremony which was attended by 12,000 people. At the closure ceremonies, Kenneth Sweeney, Enders merchant, served as master of ceremonies, Reverend Wilber R. Hoover of Enders offered the invocation, and "Hub" Robinson made the principal speech, emphasizing the benefits to the people living in the area surrounding the dam, and concluding his message with the statement, "It is surely going to be a safer, more desirable, and more enjoyable place to live."

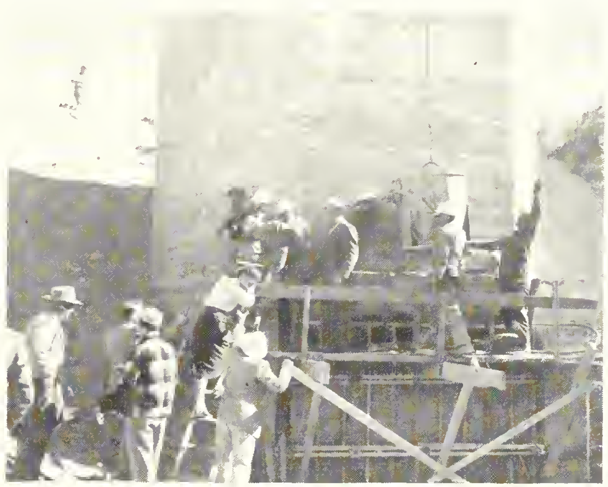


Short talks were also made by Harry Strunk, C. B. Darnell, Enders businessman; J. C. Naylor, publisher of the Imperial Republican; C. O. Crane, acting construction engineer of the Enders project; J. W. Olson of the contracting firm of Claussen-Olson-Benner, Inc., and Roy Long, secretary of the Nebraska Reclamation Association. The Chase County High School Band was on hand for appropriate musical numbers, and representatives of the local V. F. W. and American Legion raised the colors.

While the final concrete was being poured, the crowd scattered over the project, in an informal "open house" inspection. Many of them thought the most interesting feature was an underground trip to the gate chamber, nearly 100 feet below the crest of the dam. Other groups of sightseers above ground were fascinated by the skill with which steel crews played ball with red-hot rivets and air hammers while putting the finishing touches on the steel spillway gates. These gates—six steel 30 by 50 radial "locks"—have been designed to handle more than 200,000 second-feet of water. Hydrologists estimate this to be the possible peak flood-flow of the river. They also do not expect the reservoir to be completely filled except during flood emergencies.

It will take about 2 years for Enders Reservoir to fill to irrigation storage capacity. Now that storage has begun, the people in the area will soon see the lake rising gradually to its 6-mile length and its 31-mile shore line. In addition to its more utilitarian aspects, Enders Dam will provide one of the top recreation spots in western Nebraska. Facilities for fishing, boating, swimming, hunting, and picknicking are already under construction. Trees and shrubs planted in the area in collaboration with the Fish and Wildlife Service and the National Park Service last spring, have already made a notable growth. Besides beautifying the area, these plants will provide natural sanctuaries for fish and wildlife. (See article entitled "Tree Planting in the Missouri Basin," p. 161, August 1950 issue of the Reclamation Era.) Several individuals and groups heave leased a number of cabin sites, and others like the local Isaak Wal-

CLOSURE CEREMONIES at Enders Dam begin with raising of the colors, below. At right, Harry Strunk and "Hub" Robinson (wearing felt hats) have just dumped the first bucket of concrete in the closure plug at the dam.



ton League and the Wauneta and Imperial golf associations, are carrying out big plans for making Enders Dam their headquarters.

Tourists, as well as residents of nearby communities, will find a network of excellent roads leading to and from the dam. The reservoir is paralleled on the north and south by two paved Federal Highways, Nos. 6 and 34. State Highway 61 passes directly over the dam, joins these two major traffic routes, and also connects with Federal Highways Nos. 30 and 26 farther north.

If negotiations under way prevail, the recreational areas around Enders Reservoir will ultimately be administered by the Nebraska State Game, Forestation, and Parks Commission.

Recreation, and fish and wildlife protection however, are only two of the many benefits which the people of the area will receive as a result of the completion of Enders Dam.

Enders Dam is a working member of a four-dam team in the Frenchman-Cambridge division primarily designed for irrigation, flood control, and silt control. Red Willow Dam and Reservoir is to be constructed by the Corps of Engineers and integrated into the Frenchman-Cambridge division. The Bureau of Reclamation completed Medicine Creek Dam, 6 miles north of Cambridge, Nebr., on June 30, 1949, and will complete Trenton Dam, the largest of the three structures, situated 24 miles west of McCook, Nebr., on the Republican River sometime during the latter part of this year, or early in 1952.

The entire Frenchman-Cambridge division stretches from Enders to Orleans, Nebr., and includes 57,720 acres of land under the following canal systems: Cambridge, 17,300 acres; Red Willow, 11,410 acres; Meeker-Driftwood, 16,440 acres; Frenchman, 12,570 acres. Of the total, 12,350 acres, mostly in the Frenchman and Meeker-Driftwood areas, will be provided with supplemental water; the remaining acreage will be new development.

The project land area consists of a narrow strip 1 to 3 miles wide and 110 miles long. Enders, Medicine Creek, and Trenton, the Bureau's three storage reservoirs with earthfill dams, are being constructed for multiple-purpose use. Enders will have a storage capacity of 74,000 acre-feet. Of this, 10,000 acre-feet are set aside for sediment control and wildlife protection, 34,000 acre-feet for irrigation water, and 30,000 acre-feet for flood control and flood storage.

Benefits from the project development will not be confined to the irrigated area, however. When the valley lands are under irrigation, producing crops which are assured of a predictable supply of water, the large dry-farming area surrounding the irrigated farms will reap the benefits of a safe and sound agricultural economy. The three reservoirs will also protect the central portion of the Republican Basin from major flood disasters like those of 1935 and 1947. The addition of the three new man-made lakes in an area notably lacking such resources cannot be discounted in totaling the benefits of this development.

Enders is the largest of the earthfill dams in the Frenchman-Cambridge division—134 feet high, the dam itself is 2,603 feet long, with an additional dike over a mile long—6,421 feet in length, to be exact.

In constructing the dam, contractors moved almost 2 million cubic yards of earth, packing it down into the dam's structure. Where the dike section was to be raised, the ground had to be solidified. Technicians called it a "loess formation of low density," meaning that it was made up of loose soil, ranging from clay to sand, with much waste material like bones and shell which are often found in the Nebraska area. This type of soil structure was about 60 feet deep. Before the dike could be built, the contractors saturated the dike foundation by pumping 87 million gallons of water over the area, starting in March 1947 and completing the consolidation by the last of June that year. As soon as the foundation was sufficiently dry, the contractor started the work of placing the rolled filled embankment.

On the other hand, water had to be pumped out of the dam foundation. The design of the dam called for a cut-off trench (a solid-earth core to cut off the flow of water at the base of the dam) to be constructed across the valley floor and extend up each abutment to the top of the enbankment. Frenchman Creek was routed around the right abutment while the outlet works were being constructed, and the contractors struck water within a few feet of the ground surface throughout the river bottom. Open pumps and 2- to 6-inch centrifugal pumps dewatered the cut-off trench during July and August 1949.

Another problem connected with the construc-

(Please turn to page 20)

Highball for Hungry Horse

(Continued from page 3)

ever, in heavy stands of fairly large trees, the operators release the brakes on the tractor winches and allow the cable to unreel as the tractors move ahead through the timber. When most of the cable has been paid out, the operators anchor the tractors against convenient trees or stumps and reel in the cable on the powerful tractor winches. With both winches taking in cable at top speed, the ball and cable crash through the timber as fast as a man can walk, felling the trees caught in the loop of cable like a field of wheat before a terrific wind and hail storm.

The "highball" clearing method uproots practically all of the large trees. Dead snags and some of the trees snap off like matchsticks when struck by the ball or cable. Small trees are frequently only partially uprooted or are bent over without breaking. However, in bending the small trees, the cable scrapes the bark from one side of the trees, and as a result, they bleed and die quickly, turning brittle so that they are easy to stack and burn.

After the timber is snagged down, teams of tractors with bulldozer brush blades move in to stack the trees and brush for burning. Here again, one of the contractors has devised a new and ingenious way of adapting standard equipment to meet special requirements. John Trisdale's 270-horsepower "Siamese cat," which is actually two standard D-8 Caterpillar tractors bolted together side-by-side with controls centralized for operation by one man, is doing the work of three single tractors. Equipped with a special 22-foot-long brush blade, the huge land-clearing machine bunches and piles downed timber and brush at an average rate of about 1 acre per hour.

The speed with which the big reservoir-clearing job is progressing has brought approving smiles to the faces of Construction Engineer Clyde H. Spencer and the members of his staff at the Hungry Horse project, for it means that the reservoir will be ready well ahead of time for storage of 1,000,000 acre-feet of water during the spring runoff of 1952. This storage will play a vital role in helping alleviate critical power shortage conditions in the Pacific Northwest by spinning the first two Hungry Horse generators, which are scheduled to go on the line in October and December 1952, and by firming up generating capacity at downstream power plants, including Grand Coulee and Bonneville on the Columbia River. Hungry Horse Dam will also make a sizable contribution to future irrigation downstream and control of Columbia River floods. THE END

DEFENSE STRUCTURE—As truly as if it were actually the giant coastal gun it resembles is this 13½-foot penstock pipe rising from the massive concrete blocks of Hungry Horse Dam in Montana. ***Photo by A. E. McCloud, Region 1 photographer.***

Hungry Horse Concrete Pour Reaches New High

During the month of September 1950, concrete production at the Hungry Horse dam in Montana totaled 167,825 cubic yards, for a new high daily average for this project of 5,594 cubic yards. Without belittling this accomplishment, Grand Coulee Dam in May 1935 still holds the worlds unbeaten record concrete pour of 20,684¼ cubic yards of concrete poured in 24 hours.

The graveyard crew at Hungry Horse worked through extremely cold weather, however. During nine of the September nights the thermometer registered below freezing temperatures. ●

How About TCA?

(Continued from page 7)

store. When you apply 120 pounds of the TCA products, which state they contain 90 percent active ingredient, you are applying 120×0.90 or 108 pounds of the material which actually does the work. If you desire to apply 100 pounds active ingredient you must figure on 100÷0.90 or 111 pounds of the 90-percent material.

Soil-moisture conditions play an important part in the effectiveness of this chemical compound because the best results are obtained when it soaks down to the roots. Mr. Arles' best kills resulted when a half-inch of rain fell about 2 weeks after the applications, and carried the herbicide into the soil. On the other hand, heavy rains have a tendency to leach the chemical out of the soil before it can do its work. In the Southwest, October sprayings have given much better results than those in spring and summer.

Some of the shallower rooted grasses are controlled most successfully with TCA when applications are made immediately after the top growth has been cut off. But Johnson grass, which has a comparatively deep-root system, has responded better when mowed, given a few weeks to regrow to a height of about 12 to 18 inches, and then sprayed with TCA.

Following Mr. Arle's findings, R. J. McMullin, irrigation manager for the Salt River Valley Water Users' Association, treated several miles of Johnson-grass-infested canal banks with 95 pounds of TCA per acre in October 1949. Only 1 to 5 percent regrowth appeared during the spring of 1950, and these small patches are being finished off with oil sprays. Mr. Arle has found that aromatic oils are effective for spot treatments of regrowth and for controlling seedlings which come up in the treated area. His findings for general control of Johnson grass with oils were reported in the March 1950 issue of Reclamation Era. (See p. 58.)

TCA acts slowly and the roots may not decompose completely until the following spring. While TCA causes temporary sterilization, this period is comparatively short—an advantage on ditchbanks as well as in fields.

In using TCA certain precautions should be taken. The ammonium salt, which was used in some of the earlier tests, is corrosive but the sodium salt is nearly neutral. However, the solution should not come in contact with the skin, and equipment should be thoroughly flushed out after each use. Soil should not be treated in the root-feeding zone of trees, grapes, ornamental shrubs or other plants which you want to save. TCA is not supposed to be poisonous or inflammable but, as a safety measure, follow the directions given on the containers.

Some people consider TCA to be a little expensive for large scale Johnson grass control, its principal value being for smaller spot treatments or for applications to annual grasses where lower dosages are required.

In large quantities, TCA has been purchased for about 35 cents per pound, which brings the cost to $35 to $40 per acre. However, as was the case with 2,4-D, as the demand becomes greater and it is produced in larger quantities, the price may become lower. It is too soon to make price comparisons with other weed killers and TCA, but so far it is one of the most promising weed grass killers.

Testing of this chemical formulation is being continued because more information is needed before general recommendations can be given. However, if you have a grass problem that has thwarted other means of control and you believe that TCA may fit your conditions, it certainly warrants a trial. The End.

Million Dollars Saved on Anderson Ranch

Reclamation Commissioner Michael W. Straus recently announced that approximately $1,000,000 appropriated for work on Anderson Ranch Dam on the South Fork of the Boise River in Idaho has been returned to the Federal Treasury. This saving resulted from the Bureau's contracting for the required work at an amount of about $1,000,000 under the original estimate.

The estimated cost of the nearly completed dam, which will be the highest earth-fill structure in the world, has been reduced over a million and a half dollars in the past 18 months as a result of low bids. New designs and plans also resulted in a considerable savings on other work. The present estimated cost of the project is $30,714,000.

The dam, a unit of the Boise project, will provide hydroelectric power and irrigation water for the rich lands of the area. The first generator is expected to go into operation by January 1, 1951.

Report on the 19th Annual NRA Convention

(Continued from page 1)

any excuse for basic conflict. Reclamation should support all these causes—in fact, it does. The multiple-purpose reservoirs and works almost uniformly serve the recreation, fish, and wildlife functions. But again the support and advance of these resources and their conservation should be by positive, not negative, action. Recreation and fish and wildlife development should be advanced and Reclamation should not be retarded. In the unique and rare, if noisy, cases where a real conflict of interest rather than an emotional eruption develops, the collision is—as it should be—disentangled on the basis of serving the greatest interest of the greatest number."

He also warned against the increasing encroachments proposed upon what he termed "the western water customs and code that you and your predecessors have erected into the Reclamation laws, that are irrigation's hard-won Magna Carta."

Citing cases of attempts to nullify Reclamation law, he said, "Reclamation is, I believe, the only Federal agency whose basic laws say that we must protect water rights and abide by State water-right laws. Reclamation strongly supports and adheres to this provision. Strange to say, there are some who are attempting to misuse the recent decision of the United States Supreme Court in the Gerlach California case in an effort to mislead the people into believing that Reclamation sought to deprive the people of their water rights. The best way to demonstrate conclusively that this is a complete and unmitigated falsification is to quote some of the language of the Supreme Court in its decision. Mr. Justice Jackson, giving the decision of the Court, said, "We are guided to this conclusion by the interpretation placed on Congress's acts by the Reclamation Bureau. . . . We are advised by the Government that at least throughout administration of California Reclamation projects it has been the consistent practice of the Bureau of Reclamation to respect such property rights." And in his concurring opinion, Mr. Justice Douglas, from this State of Washington, pointed out that this was the practice of the Bureau of Reclamation not only with respect to California projects but with respect to Reclamation projects generally in the 17 western States

V. I. P.—Hon. John R. Murdock of Arizona, Chairman of the House Public Lands Committee, was one of the many important personages attending the N. R. A. Convention, which featured tours of Grand Coulee Dam (before which Senator Murdock is standing), the Columbia Basin project, and the Trentwood Aluminum Rolling Mill.

in which the Bureau operates. Justice Douglas said, and I quote:

> This Court has recognized, however, that administration of the act [by which Justice Douglas meant the Reclamation law] is to be in conformity to State laws.—Whatever doubts there may be are for me dispelled by the administrative practice under the act, as summarized by the Commissioner of Reclamation in a memorandum dated April 19, 1950. Reports from the seven regional counsel and a review of the files in the Bureau of Reclamation formed the basis for the memorandum. The Commissioner concluded that it has been the almost invariable practice of the Bureau to file notices of appropriations under State law without regard to whether the stream involved was navigable or nonnavigable. Such filings were made pursuant to State law on water rights riparian to at least 13 navigable or probably navigable rivers. . . . Moreover, the Commissioner of Reclamation has drawn our attention to recent public statements by Department of the Interior officers confirming this practice.

Commissioner Straus concluded by pointing out that the National Reclamation Association was established and exists primarily for the purpose of creating unity, saying "It is bound by its constitution and bylaws to support the Reclamation laws, philosophy, and program of the West," and urging the members to work for unification and agreement.

THE END.

Central Valley's Flood Lesson

(Continued from page 13)

to Congress in November 1950, prepared long before the devastating flood, involves a plan designed to provide protection against repetition of the havoc wrought in the Pacific Coast State, along with its other multiple purposes. The legislation would authorize construction of eight additional reservoirs in the Central Valley project, all working together with the present water-control facilities, on the seven rivers which raged uncontrolled through the Valley and caused loss of life, destruction of homes, and crop and property damage running into millions of dollars.

The legislation sent to the Congress was designed to carry out the President's Folsom Formula under which all multiple-purpose reservoir projects are the responsibility of the Bureau of Reclamation, while facilities purely for the control of floods are the responsibility of the Army Corps of Engineers.

The bill would reauthorize the Central Valley project to include eight reservoirs, with a combined storage capacity of 3,465,000 acre-feet: Black Butte on Stoney Creek; Isabella on Kern River; New Hogan on Calaveras River; New Melones and Tulloch on Stanislaus River; Pine Flat on Kings River; Success on Tule River, and Terminus on Kaweah River. (See map on p. 12 and 13.)

Under the proposed legislation, the Central Valley project would include these eight reservoirs for the purpose of flood control, irrigation, and power. These reservoirs and the works associated with them would be coordinated and integrated physically and financially with the operation of the other features of the Central Valley project. The Bureau of Reclamation would construct, operate, and maintain the Black Butte, New Hogan, New Melones, and Tulloch Reservoirs and works associated therewith; construct and operate and maintain hydroelectric power plants at New Melones, Pine Flat, and Tulloch Reservoirs, and related transmission facilities; and operate and maintain the Isabella, Pine Flat, Success, and Terminus Reservoirs upon their completion by the Corps of Engineers.

Meanwhile, the Bureau of Reclamation continues its assignment to save and use wisely the waters of the West for the greatest benefit to the greatest number of people. The present Central Valley structures proved their worth during the November 1950 floods, and dramatically illustrated the gaps in California's water-control works. The End.

The Story of Enders Dam

(Continued from page 16)

tion of Enders Dam was that of obtaining rock for riprap, and sand and aggregates for concrete. The contractors processed the most durable rock available in the area for the crushed rock gravel blanket, but were unable to find enough suitable rock in the area for the riprap, which was shipped in by rail from Guernsey, Wyo. The same situation occurred with regard to sand and aggregates. Most of the Republican River sand and gravel was not hard enough to meet Bureau standards nor did it have the mineral content which would assure a lasting, durable concrete. Some aggregates (one-fourth- to three-fourths-inch size) were supplied at a plant on the South Platte River near Ogallala, Nebr., and hauled 70 miles by truck to the dam site. The three-fourths- to 1½-inch size was mostly shipped from Golden, Colo., and Guernsey, Wyo. The contractor dry-batched the concrete at a separate batching plant and trucked it to one of two 34-cubic-foot capacity paving mixers.

The first concrete for Enders Dam was placed on September 2, 1947, in the invert of the circular conduit of the outlet works. The contractors concentrated on this structure so the river could be diverted through the outlet works and work on the dam cut-off trench could be completed.

Enders Dam was designed and constructed by the Bureau of Reclamation under the direction of L. N. McClellan, chief engineer. During the major part of the construction, U. V. Engstrom, construction engineer, was in charge, and the Wunderlich Contracting Co. performed the greater part of the construction work. Glanssen-Olson-Benner, Inc., completed the project, and C. O. Crane, formerly field engineer, continued the work as acting construction engineer.

Water is now rising behind Enders Dam, another testimony to the perseverence, cooperation, and ingenuity of the American people, and their faith in the future of the West. The End.

Warne In Hawaii

William E. Warne, Assistant Secretary of the Interior, left for Hawaii on November 27 to participate in hearings to be held by Governor Ingram Stainback for the purpose of determining water development possibilities in the islands.

The program was made possible when Congress, in approving the appropriation act this year, included a special provision instructing the Department of the Interior to explore the possibilities of Hawaiian water resource developments which could be undertaken by the Bureau of Reclamation, and specifically called for a report on this subject to be made to the next Congress.

If the Department of the Interior is granted funds and authority to undertake the necessary work in Hawaii, Reclamation experts will develop plans and build projects to harness and use for irrigation and other purposes power-development water that is now being lost. •

Private Business Helps Government Save Irrigation Water

Private business concerns, donating time, equipment, and materials without cost to the Government, are working with the Bureau of Reclamation to reduce water-seepage losses in the irrigation canals of the West.

Besides furnishing products for laboratory study in the Bureau's Engineering Center at Denver, Colo., the companies are cooperating with the Government in field studies in eight Western States to develop a lower-cost lining for the ditches which last year poured Federal Reclamation water on more than 5,000,000 thirsty acres to provide crops valued at more than a half-billion dollars. Under present conditions, losses from seepage amount, in some instances, to a third or more of the water entering the canals.

While Bureau nuclear experts at Denver explore the use of "tagged atoms"—radioisotopes—to trace the course of seepage in irrigation canals (see Atomic Detectives, p. 153, August 1950 Reclamation Era) canal lining research has been principally in the fields of portland cement concrete, asphaltic concrete and membranes, and selected earth materials, Reclamation Commissioner Michael W. Straus reported to Secretary Chapman recently.

Among organizations and companies participating were the Portland Cement Association of Chicago; the Asphalt Institute of New York City; Madsen Iron Works of Huntington Park, Calif.; Barber-Green Co., of Aurora, Ill.; Hercules Powder Co., of Wilmington, Del.; Stanacal Asphalt Bitumuls Co., of San Francisco; the Presstite Engineering Co., of St. Louis; Kerr-McGee Oil Co., of Oklahoma City; Owens-Corning Fiberglas Corp. and Shell Oil Co., of San Francisco, Socony-Vacuum Co., of Kansas City; Union Oil Co., of Los Angeles; Husky Refining Co., of Cody, Wyo.; and the Lion Oil Co., of Eldorado, Ark.

Examples of outstanding contributions include the Portland Cement Association's sponsorship of the most elaborate of the Reclamation-private industry tests, the installation of a three-fourths mile of soils cement lining in a W. C. Austin project lateral. Through cooperation with Madsen Iron Works it arranged for the construction and use of a special subgrade guided slip-form for placing the cement. The Hercules Powder Co. supplied large quantities of commercial resin, Stabinol, and helped apply it in experimental stabilization of earth lining on the same project. •

L. R. Douglass Named Boulder Canyon Head

Louis R. Douglass, former assistant director of the Bureau of Reclamation's Region 3, with headquarters at Boulder City, Nev., is the new director of power of the Boulder Canyon project at Hoover Dam. The appointment was made by the Secretary on the recommendation of Regional Director E. A. Moritz.

Mr. Douglass succeeds Carlo P. Christensen, who died last June 15.

The change in positions moved Mr. Douglass from his regional office in the Bureau of Reclamation's administration building in Boulder City, Nev., to a project office across the hall. The regional and project headquarters are under the same roof.

Joining the staff of the chief engineer's office of the Bureau of Reclamation at Denver, Colo., in September 1933, with a background of more than 20 years of experience gained in the field of engineering in the Western States, Mr. Douglass has been with the Bureau of Reclamation for the past 17 years. His first assignment with the chief engineer's office was in the division of design of concrete and earth dams, and appurtenant structures. While there he was actively engaged in design of certain phases of the Hoover Dam, which was then under construction. •

WATER REPORT

During November, floods in California and Nevada increased off-season storage in several Reclamation reservoirs. On the Central Valley project in California about a quarter of a million acre-feet of water was caught and stored behind Shasta and Friant Dams. These waters will be available for irrigation and power in the parched valley when released next irrigation season. In Nevada, on the other side of the Sierras, floodwaters filled Boca Reservoir on the little Truckee River, and accounted for most of the 235,000 acre-feet rise in the reservoirs that serve the Newlands project. In the Pacific Northwest several projects report unusually wet weather for November and most reservoirs stand at above seasonal normal. While the flow of the Colorado River into Lake Mead has been reported below normal for several months, the reservoir still contains ample water for next season's needs.

The reservoirs of projects in the Great Basin generally stand at favorable levels. The Salt River and the Rio Grande projects continue to report water scarcities and heavy spring and winter precipitation is needed to improve their condition. Most of the reservoirs in the Missouri Basin were reported to have near normal inflow and to have a favorable seasonal storage.

By regions the situation is as follows:

Region 1, the northwest region—the irrigation water situation is favorable; the storage and the flow into the reservoirs of most projects are above seasonal normal. Above normal snow and rains were reported in several projects. While the flow into the reservoirs of the Vale project in Oregon was above normal during November, above normal yield from the watershed is required this spring and summer because the seasonal storage is lowest since the Agency Valley Dam was built.

Region 2, record breaking floods occurred on most of the streams draining the Sierra Nevada into the Central Valley of California, improving the San Joaquin Valley's water supply situation considerably. Flood flows materially increased Orland project storage, although they had little effect on storage in Klamath project's reservoirs. Shasta and Millerton Lakes in November reached record high levels. In addition to storing precious water for next year's crops, these two dams prevented serious flood damage below them.

Region 3, including Arizona, southern California and Nevada, and western New Mexico—the flow into the region's reservoirs has been below normal during the month. The reservoir behind Roosevelt Dam on the Salt River project is lowest in ten years and water continues to be scarce on the project. While the flow into Lake Mead has been below normal, there is ample storage to irrigate the crops in the lower Colorado River Valley.

Region 4, the intermountain region—storage in the reservoirs serving the Newlands project has increased 235,000 acre-feet during November, due mostly to floods occurring during the latter part of the month. Except for the Mancos project in Colorado, the remaining reservoirs stand at favorable seasonal levels. On the Mancos project the season has been very dry and very little snow is reported in the mountains.

Region 5, including New Mexico, Oklahoma, Texas, and southern Colorado—the irrigation season on the W. C. Austin project will close during the first part of December instead of its normal ending October 15. The summer season was the wettest of record followed by eleven weeks of drought. Most of the reservoirs of the region stand at a favorable seasonal level in spite of the below normal inflow during the last few months. The situation on the Rio Grande, where the Elephant Butte reservoir stored less water than any November since 1918, is reported critical. No stored water is being released for winter irrigation, and soil moisture is low.

Region 6, the upper Missouri Basin—melting snow has kept the flow into the reservoirs on the St. Mary and Milk Rivers above normal. The reservoir levels in the region generally are favorable and their inflows are near normal or above.

Region 7, the lower Missouri Basin, including the North Platte—a generally favorable outlook for irrigation needs next year. Closure was made of Cedar Bluff Dam on the Smoky Hill River in Kansas during November and storage in the reservoir commenced. ●

CROPS

Thirty-five hundred acres of wheat in Washington produced certified seed this year. Yields were 25 to 30 bushels an acre around Ritzville and Lind and about 60 bushels in more humid locations.

Apples of the 1949 crops shipped from the Yakima Valley totaled 11,673 carloads, compared with 10,039 the year before. The last old-crop Winesaps, 2 carloads sold on the New York market in July 1950; brought for 1 car, $7.21 per box, and for the other, $7.03.

The Oregon production of fruits and berries in frozen pack during 1949 amounted to 64,000,000 pounds. Frozen vegetables processed totaled 62,000,000 pounds.

(Three items above reprinted from the October 1950 issue of The Northwest, publication of the Northern Pacific Railroad.)

LETTERS

Interesting and Useful

Allahabad U. P., India,
April 29, 1950.

Dear Editor: I have herewith to thank you for your kind courtesy in sending the Reclamation Era, which I have been receiving since November 1949. I have read the articles with interest and have to say that the publication though primarily intended for giving information regarding activities of the Bureau of Reclamation to the taxpayers in America, provides interesting and useful information to all engineers connected with reclamation service in their countries elsewhere.

Yours faithfully,
Shri Yadava Mohan, I. S. E.,
Consulting Engineer,
Rihand Construction Circle.

Best of Twenty-Two

T. C. Butler, Jr., consulting engineer and associate, Continental Bank Building, Boise, Idaho, recently appended this welcome note to a letter asking for back copies of the Era:

"Let me express my approval of and appreciation for Reclamation Era; one of the very best magazines that reaches me out of a total of 22 periodicals.

"I believe it is doing a wonderful lot of good for reclamation and therefore for the American people who benefit by it to the last 100 percent of the population, east, west, north, and south."

Incidentally, we have a limited supply of back copies which we are glad

send upon request. The single copy
ice is 15 cents, with reduced rates
r quantity purchases as follows:

6 to 9 copies_________ 12 cents each.
10 to 50 copies________ 10 cents each.
50 or more copies_____ 8 cents each.

Make out check or money order to
e TREASURER OF THE UNITED
'ATES, and send request to the Bu-
au of Reclamation, United States De-
rtment of the Interior, Washington
, D. C. Please do not send stamps.
or small orders, coins will be ac-
pted.

Service Through Simplicity

2420 RIDGE ROAD,
BERKELEY 9, CALIF.,
March 15, 1950.

DEAR EDITOR: I am a graduate student
farm economics now in attendance at
e University of California, and a
gular subscriber to the RECLAMATION
A. For the last year or two, at the
quest of a friend of mine who is now
charge of the division of water util-
tion with the Israeli Department of
riculture, I have obtained for him
ta on costs of water for irrigation in
e West and how to go about computing
em.

Your article Measuring Well Water,
H. R. McDonald, fills a long-felt need
this field. It is clear and comprehen-
ble to farmers without the benefit of
ollege course in calculus or the ability
compute lengthy formulas.

(1) Could you, please, secure for me
o reprints of this article to be sent to
e division of water utilization in
rael and translated into Hebrew?

(2) Have you any other published
terial on simple devices for measur-
g water (in pamphlet form) or is the
ove article abridged from the differ-
t experiment station bulletins which
e quite comprehensive, but (on the
nole) too technical for the use of
rmers—as we were able to see in the
ld?

Your cooperation will be much ap-
eciated.

Sincerely yours,

(Sgd) BEN PRAGER.

After several years of crusading
ainst Government Gobbledygook, and
ecialized technical terminology, a let-
like this makes us feel our battles
ainst verbal mumbo jumbo have not
en in vain. Men and women working
the job of transforming western deserts into blooming oases, and wilder-nesses into flourishing farmlands, have piled up an amazing amount of know-how—over a half century's worth. We believe this information should be shared with the people who use and pay for the water and electricity made available as a result of the Bureau's work. Most of the people in the recla-mation area are highly educated, but none of them can be expected to be specialists in every subject concerning reclamation, or be familiar with the technical terms which become working tools to the technicians. Therefore, our aim has been to translate helpful and useful technical information into popu-lar, easy-to-read and easy-to-understand vernacular. It is good to know that once in a while we succeed, and that the cooperation of our contributors and their help in popularizing reclamation science are appreciated.—Ed.

ERA Subscriber for 34 Years

P. O. Box 194,
BURLEY, IDAHO,
June 12, 1950.

DEAR EDITOR: Enclosed is a money order made out to the Treasurer of the United States in the amount of $5 in payment for 10 years' subscription of the RECLAMATION ERA, beginning with the January 1950 issue, if possible.

I have been a Bureau of Reclamation employee since April 24, 1916, and have always enjoyed the magazine.

If the rate of 50 cents per year will be changed to $1 per year, if and when I retire, the number of years covered by this subscription can be reduced accordingly or I can then make an extra payment to cover the difference in amount paid now and what will be due until the end of the 10-year period.

Sincerely yours,

(Sgd.) MISS ANNA J. LARSON.

Is this a record? The ERA would be interested in hearing from other long-time subscribers who have kept in touch with Bureau of Reclamation activities through its official monthly publication.—Ed.

Correction

In the "Sand Trap Blues" article appearing in the November 1950 issue of the ERA we located coauthor Milo W. Hoisveen at Bend, Oreg., instead of at his correct headquarters, Ephrata, Wash. We regret this error.

RELEASES

Wyoming's Coal Resources

Coal reserves in Wyoming total 121 billion tons according to the Geological Survey which is conducting a survey of these reserves throughout the United States, and compiling their reports also as part of the Department of the Interior's program for development of the Missouri River Basin.

For the sake of comparison, this reserve shapes up favorably with those of Montana and North Dakota, while it exceeds that of Pennsylvania and is slightly less than that of West Virginia.

This total of 121 billion includes 13 billion tons of bituminous coal and 108 billion tons of subbituminous coal, which together equal or exceed 20 cubic miles of solid fuel. More than one-half of the "black gold" is used extensively for railroad fuel. Approximately one-fourth of the supply is exported to other States for industrial uses and retail sales. Some of it is shipped as far away as Minnesota and Washington.

This appraisal of Wyoming's coal reserve is being used to evaluate the energy resources of the Northwest. The finding is a result of extensive study and research of the Geological Survey files and material provided by coal mining and oil companies, along with numerous individuals in Wyoming.

For the complete story of Coal Resources in Wyoming, by Henry L. Berryhill, Jr., Donald M. Brown, Andrew Brown, and Dorothy A. Taylor, write to Geological Survey, Washington 25, D. C., for free copies of the report. ●

Hoover Dam Movie Goes Abroad

A movie, with sound, of Hoover Dam, is now being circulated to foreign countries under the auspices of the International Motion Pictures Division of the United States Department of State. This 42-minute film which is available in 16- and 35-millimeter rolls, includes some of the Bureau of Reclamation's footage on Hoover Dam, and was given a special production treatment for the State Department, which has also prepared a film guide which carries "stills" from the film, background information, and suggestions for using the film in

foreign countries, where the audiences hold discussion programs following the movie show.

Quoted from the State Department brochure is this statement, "Of primary and obvious importance, the film is valuable as a picturization of one of the great engineering feats of modern times. The grandeur and scope of the project which made Hoover Dam possible are dramatically presented. In this respect, the film furnishes audiences abroad with a splendid example of America's ability to mobilize the forces of Nature, the skills of modern engineering, and the resources of the Nation to assist the people in controlling their own destiny." ●

Don't Overirrigate

Overirrigation wastes water and can even be harmful to crops and soil. Applying more water than a soil will hold can cause deep percolation that will leach out valuable plant foods, such as nitrates, to a depth below the feeder roots of plants.—(*From The California Farmer, p. 45, July 15, 1950, issue.*)

NOTES FOR CONTRACTORS

Contracts Awarded During November 1950

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
3146	Columbia Basin, Wash.	Nov. 17	2 230,000/196,000-volt circuit breakers for Grand Coulee 230-kilovolt left switchyard, schedule 1.	Westinghouse Electric Corp., Denver, Colo.	$113, 900
3182	Missouri River Basin, Nebr	Nov. 15	1 lot of embedded gate anchorages for 3 42- by 30-foot radial gates at Trenton Dam.	Willamette Iron & Steel Co., Portland, Oreg.	22, 750
3186	Columbia Basin, Wash.	Nov. 28	2 portable oil purifiers for Granc Coulee power plant.	De Laval Separator Co., Chicago, Ill.	14, 310
3193	Colorado-Big Thompson, Colo.	Nov. 7	Construction of 72 miles of Brighton-Hoyt-Brush 115-kilovolt transmission line.	Malcolm W. Larson, Denver, Colo.	516, 516
DS-3200	Columbia Basin, Wash.	Nov. 14	Motor-control switchgear assembly and 1 spare circuit breaker removable element for Quincy pumping plant.	General Electric Co., Denver, Colo.	34, 188
DS-3201	Central Valley, Calif.	do.	3 traveling water screens for laterals 92.2W and 93.2E for Lindmore irrigation district, Friant-Kern Canal distribution system.	Link-Belt Co., San Francisco, Calif.	23, 649
DS-3202	Davis Dam, Ariz.-Nev.	Nov. 22	1 100-ton traveling crane for machine and apparatus repair shops, system operations, and maintenance area.	Moffett Engineering Co., Albany, Calif.	49, 920
DS-3205	Central Valley, Calif.	Nov. 14	13 vertical-shaft, turbine-type pumping units for L3 and L4 pumping plants, laterals 93.2W, 93.2E, and 93.2E-0.1S, Unit 3, Lindmore irrigation district, Friant-Kern Canal distribution system, schedule 1.	Food Machinery & Chemical Corp., Los Angeles, Calif.	16, 767
DC-3206	Rio Grande, N. Mex.	Nov. 27	Construction of 80 miles of Socorro Albuquerque 115-kilovolt transmission line, schedule 1.	Reynolds Electrical and Engineering Co., Inc-, El Paso, Tex.	624, 419
DS-3220	Missouri River	Nov. 9	Fabricated structural steel for Boysen switchyard and Alcova-Boysen and Boysen-Thermopolis 115 kilovolt transmission line.	Union Steel Co., Los Angeles, Calif.	47, 841
DS-3225	Missouri River Basin, N. Dak	Nov. 30	6 potential transformers for Devils Lake and Jamestown substations.	General Electric Co., Denver, Colo.	19, 200
R3-PX-55	Davis Dam, Ariz.-Nev.	Nov. 1	Switchyard control and relay board for Phoenix substation	General Electric Co., Phoenix, Ariz.	15, 703
R3-B-21	Boulder Canyon, Ariz. Calif.-Nev.	Nov. 8	Air-conditioning system for the municipal building at Boulder City.	Valley Sheet Metal Co., Phoenix, Ariz.	21, 670
R3-PX-44	Davis Dam, Ariz.-Nev	Nov. 10	Deep-well pumps and piping for Mesa, Coolidge, and Tucson substations and System O&M area.	Thomson Plumbing & Heating Co., Phoenix, Ariz.	58, 553
R6-Bil-8	Buffalo Rapids, Mont	Nov. 8	Construction of additional canal and waste-way structures	Long Construction Co., Billings, Mont.	31, 994
617C-20	Riverton, Wyo.	Nov. 6	Asphaltic undersealing of approximately 2,400 lineal feet of concrete canal lining between stations 215+00 and 234+00 and stations 244+00 and 250+00, Wyoming Canal.	Studer Construction Co., Billings, Mont.	13, 200
R7-157	Missouri River Basin, Kans	Nov. 22	Constructing residence and maintenance facilities building at Cedar Bluff Dam.	Hunter Construction Co., Hays, Kans.	24, 000

Construction and Material for Which Bids Will Be Requested By March 1951

Project	Description of work or material
Boise, Idaho	Excavation of East Hartley Gulch drain near Caldwell, Idaho.
Do.	Surfacing roads at Anderson Ranch Dam.
Central Valley, Calif.	780,000 cubic yards of excavation of river channel below Pacific Gas & Electric Co. dam and power plant; 118,000 cubic yards of excavation for penstocks; and 92,000 cubic yards of excavation for foundation of Folsom power plant, on American River near Folsom, Calif.
Do.	Replacing 2 2-mile wood-pole sections of Shasta-Tracy 230-kilovolt transmission line with steel tower sections by erecting steel towers, restringing conductor, and stringing new ground wires.
Do.	Construction of 48 miles of 12- to 54-inch diameter concrete pipe lines for the Southern San Joaquin municipal utility district on the Friant-Kern Canal distribution system near Delano, Calif.
Central Valley, Calif.	Coustruction of 9 miles of 12- to 33-inch diameter reinforced concrete pipe Lateral 74.6E for the Exeter irrigation district on the Friant-Kern Canal distribution system near Exeter, Calif.
Do.	Construction of 8.5 miles of 12- to 48-inch diameter welded-steel pipe lines for Lindsay-Strathmore irrigation district on the Friant-Kern Canal distribution system 2 miles east of Linsay, Calif.
Do.	Resurfacing streets and constructing curbs, gutters, and sidewalks at Shasta Dam government camp near Redding, Calif.
Colorado-Big Thompson	Construction of 370,000-cubic-yard earthfill Willow Creek Dam for diversion of Willow Creek water to Granby Reservoir; construction of 2.5 miles of 20- to 24-foot wide access road; and construction of 2.6 miles of 13.8-kilovolt, wood-pole transmission line.

Construction and Material for Which Bids will be Requested by March 1951 (cont'd.)

Project	Description of work or material
olorado-Big Thompson	Construction of 90-foot high, 285,000-cubic-yard earth-fill Rattlesnake Dam, 14 miles west of Loveland, Colo.
Do	Construction of a concrete diversion dam and 12.4 miles of North Poudre supply canal extending northeast from the Cache la Poudre River, 18 miles northwest of Fort Collins, Colo.
Do	Construction of 90,000-kilovolt-ampere Flatiron switchyard, afterbay dam, and Flatiron power plant and pumping plant building to house 2 35,000-kilovolt-ampere generators and 1 370-cubic-foot-per-second capacity, 240-foot head, centrifugal pump, on South Cottonwood Creek 9 miles west of Loveland, Colo.
Do	Construction of Flatiron section of Horsetooth feeder canal, including 1.5 miles of concrete-lined canal, a 700-foot tunnel, and 2 500-foot siphons, 10 miles west of Loveland, Colo.
Do	Construction of 56 miles of Poncha Springs-Gunnison wood-pole 115-kilovolt transmission line.
Do	Construction of 36 miles of Flatiron-Fort Collins-Cheyenne Tap 115-kilovolt transmission line.
Do	Dispatcher's board for Flatiron dispatcher's building.
olumbia Basin, Wash.	Construction of 91 miles of laterals ranging from 2 to 300 cubic feet per second capacity to irrigate 20,065 acres in lateral area E-3 on East Low canal 8 miles southeast of Moses Lake, Wash.
Do	Installation of complete heating and ventilating system in units R-1 to R-9, Grand Coulee right power plant, and installation of supplemental and miscellaneous heating and ventilating system in units L-1 to L-9, left service bay and left control bay, Grand Coulee left power plant.
avis Dam, Ariz.-Nev.	Constructing foundations and erecting a 12.5-kilovolt steel structure for Coolidge substation near Coolidge, Ariz.
Do	Construction of a fire station at system operation and maintenance area near Phoenix, Ariz.
Do	Completion of architectural finish work and miscellaneous installations of equipment in Davis Dam power plant, forebay and spillway structures.
eschutes, Oreg.	Placing pneumatically applied mortar canal sealing on North Unit Main canal near Bend, Oreg.
ort Peck, Mont.	Construction of 14 miles of 69-kilovolt wood-pole transmission line between Fort Peck and Glasgow Bench, Mont.
ungry Horse, Mont.	Completion of 285,000-kilowatt Hungry Horse power plant at Hungry Horse Dam.
endrick, Wyo.	Construction of 40 miles of 34.5-kilovolt transmission line between Seminoe and Bairoil, Wyo.
Kendrick, Wyo.	Placing buried asphalt membrane lining of 1,700 feet of existing 600-cubic-feet-per-second capacity Casper canal.
Missouri River Basin, Nebr.	Construction of 11 miles of unlined and 2 miles of concrete-lined reaches of 685-cubic-feet-per-second capacity Courtland canal 4 miles southeast of Superior, Nebr.
Do	Construction of 14 miles of Courtland laterals to irrigate 3,464 acres.
Do	Three 42- by 30-foot radial gates for Trenton Dam.
Missouri River Basin, N. Dak.	Relocation of 2 miles of county road and raising of a county bridge near Dickinson Dam site.
Missouri River Basin, S. Dak.	Construction of 112 miles of 115-kilovolt transmission lines with overhead ground wires near Rapid City, Wasta, and Midland, S. Dak.
Do	Construction of 75 miles of 115-kilovolt transmission lines between Fort Randall, Gregory, and Winner, S. Dak.
Do	Construction of a 30-mile reach of concrete- and asphalt membrane-lined Angostura canal, and lateral and drainage systems, about 10 miles southeast of Hot Springs, S. Dak.
Missouri River Basin, Wyo.	Construction of 6,000-kilovolt-ampere Sinclair substation.
Do	Installing power plant equipment at Boysen power plant, 21 miles south of Thermopolis, Wyo.
Do	Relocation of 4 miles of county road at Keyhole Dam site 15 miles northeast of Moorcroft, Wyo.
Do	Relocation of 6 miles of U. S. Highway No. 14 at Keyhole Dam site and construction of a 3-span bridge 15 miles northeast of Moorcroft, Wyo.
Do	Installation of 2.5 miles of remote control cable between Seminoe and Kortes power plants.
Paonia, Colo.	Construction of 3.3-mile extension of Fire Mountain Canal near Paonia, Colo.
Do	Reconstructing and enlarging 3.4-mile Overland Canal to an initial capacity of 140 cubic feet per second, near Paonia, Colo.
Rio Grande, N. Mex.	Construction of 15,000-kilovolt-ampere Albuquerque substation.
Do	Construction of 52 miles of 115-kilovolt, wood-pole transmission line between Belen and Willard, N. Mex.
Do	1 control board, 1 125-volt battery charger, and 1 240/120-volt power distribution cabinet for Albuquerque substation.
Riverton, Wyo.	Placing asphalt lining on 17 miles of 565-cubic-feet-per-second Wyoming Canal.

United States Department of the Interior
Oscar L. Chapman, Secretary
BUREAU OF RECLAMATION OFFICES

Washington Office: United States Department of the Interior, Bureau of Reclamation, Washington 25, D. C.

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OUR FRONT COVER

FROZEN FALLS

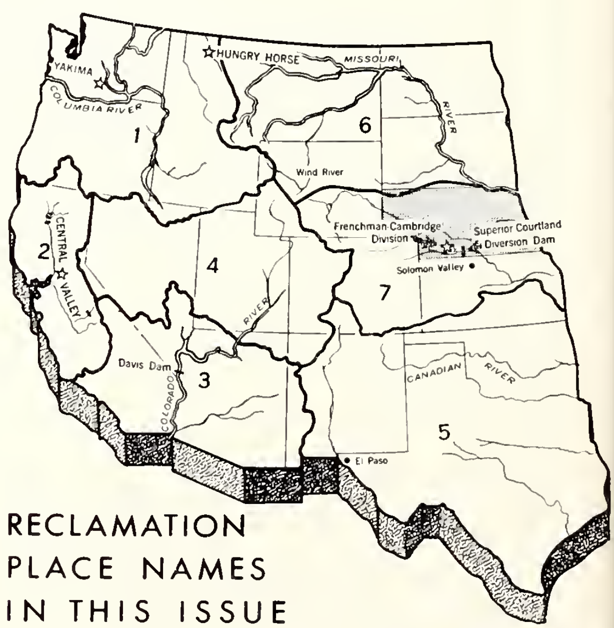
THREE MEN ON HUNGRY HORSE work through subzero temperatures, drilling inspection holes 3 feet in diameter in the bedrock foundation for the dam. This photo, taken on December 12, 1949, by A. E. McCloud, shows (from left to right) Dick Kangas, Roddy Popovich, and Atni Kangas working on the calyx drill rig set-up on the left abutment.

30 YEARS AGO IN THE ERA

Wrapping Apples in Oiled Paper Cuts Down Scald Loss

Wrapping apples in oiled paper has been found to prevent apple scald, a cause of heavy loss during storage and transportation. As a result of investigations by the United States Department of Agriculture, a great many of the fancy packed apples are likely to go out next year in oiled instead of plain wrappers. . . . A good quality of oiled wrapper can be prepared by hand, but the cost of labor is too great. The oiled paper on the market in 1920 had been prepared for other purposes and was too heavy for convenient use, but manufacturers are now preparing lighter weight oiled papers for the 1921 crop.

(From p. 60, February 1921 issue of the RECLAMATION RECORD, predecessor to the RECLAMATION ERA.)



RECLAMATION PLACE NAMES IN THIS ISSUE

BLAST THE SILT

by S. T. LARSEN, O&M Liaison Officer, Branch of Design and Construction, Denver, Colo.

Have you ever had to clean silt from a small concrete weir pool? Perhaps you have used a horse-drawn slip scraper, a hand shovel, or a dragline. No matter what method you use, you must admit they leave much to be desired.

Except for hand shoveling, which is downright laborious, there is the expense and trouble involved in getting equipment out to the weir. Nowadays, mounting labor costs add to the problem of keeping small weir pools in good operating condition, at a reasonable outlay of cash.

Operation and Maintenance forces on the Riverton project in Wyoming think the answer to the problem is dynamite! People have been using dynamite to blast wet and mucky material out of drain channels for many years—why not apply that method to cleaning weir pools? In answering that question, the O&M group sacrificed a few structures during the experimentation period, but now believe the process is as safe and sound as any dynamiting technique. It would be wise, however, to follow the instructions carefully, keeping in mind the fact that the Riverton forces blasted some weirs out of business during the testing period.

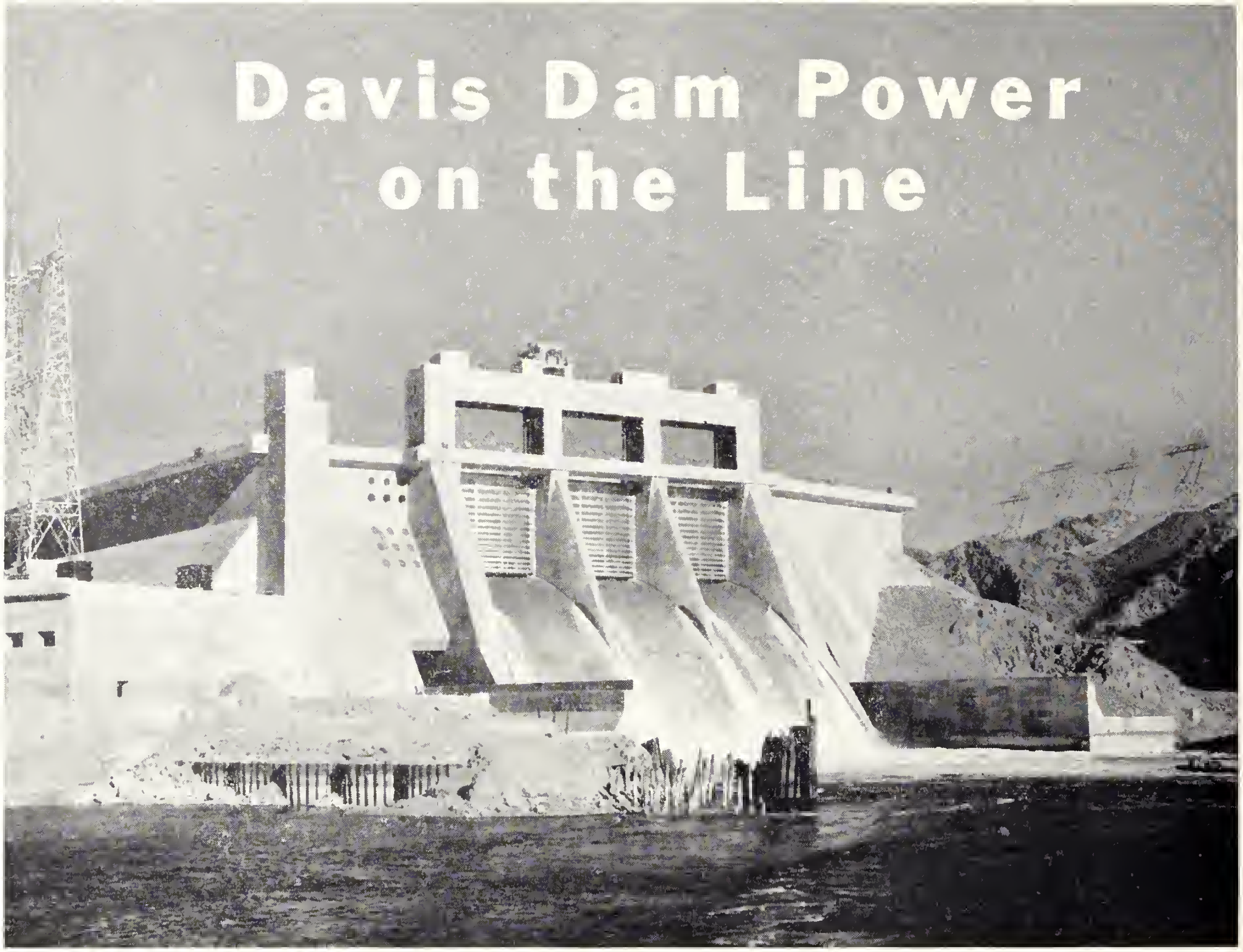
If the pool is dry, saturate it first. This will make it possible for the shock to progress from one stick of dynamite to the next, as the water assures a pressure wave throughout the area which serves as a detonator. Saturating the pool will also make it easier for you to poke holes in the silt for the dynamite sticks. Use a wooden stick about 4 feet long and 1½ inches in diameter and locate the holes, each 18 inches deep, along the center line of the weir pool. The first hole should be about 5 feet upstream from the weir blade, the others extending upstream to the upper end of the pool spaced about 16 to 18 inches apart. Use ditching dynamite of 50 percent strength.

SILT'S LOADED by maintenance man Hoshaw, above. At right, Silt Away! Below, same pool less silt. *Photos by Karl Powers, Riverton project.*

Place a half-pound stick of dynamite in each hole and press it to the bottom of the hole by using the wooden stick. Save a hole in about the middle of the line for the priming charge. After you have filled all the other holes with dynamite sticks, set the "primer" stick last, with the waterproof fuse and cap, or electric detonator, in place. Light the fuse, or plunge the detonator, and watch the charge explode, throwing the silt out of the pool and scattering it where it will no longer be

(Please turn to page 41)

Davis Dam Power on the Line



Power from the Bureau of Reclamation's fourth largest source, Davis Dam and power plant, located 34 miles west of Kingman, Ariz., on the Colorado River between Arizona and Nevada, is now on the line.

During the first part of January, the first of five 45,000 kilowatt capacity generators in the Davis Dam power plant at Pyramid Canyon started turning. The schedule calls for one generator to go in production each month until the plant is completed, but it is expected that this schedule may be bettered. The estimated output of all generators is expected to be approximately a billion kilowatt-hours of energy per year.

Power produced at Davis Dam this year will be in time to aid the irrigation farmers in the Southwest who in the past have suffered crop losses because of insufficient power for pumping. Acute shortages of power for this purpose were experienced in the Salt and Gila River Valleys of Arizona, southeast of the project.

Davis Dam, the last of the large Reclamation dams to be built below Hoover Dam in the presently planned development of the Colorado River, uses the last major power drop in this section of the river. It is the last step in the stairway of river dams on the lower Colorado stretching from Laguna Dam, 13 miles northeast of Yuma, Ariz., to Hoover, over 300 miles upstream. Other structures include Parker and Imperial Dams and the great All-American Canal. An undeveloped low power drop still exists at Pilot Knob, which will be utilized when surplus water from the All-American Canal is used.

With the beginning of power generation the project will be fulfilling the multiple purposes for which it was built, namely (1) to service treaty provisions pertaining to the division of Colorado River waters between the United States and Mexico; (2) to produce needed hydroelectric power and (3) to reregulate irregular water releases from Lake Mead through the Hoover power plant for

CHAPMAN STARTS FIRST DAVIS GENERATOR

On January 5, 1951, at his Office in the Interior Department, Secretary of the Interior Oscar L. Chapman pressed a telegrapher's key and put into commercial operation the first big generator at Davis Dam.

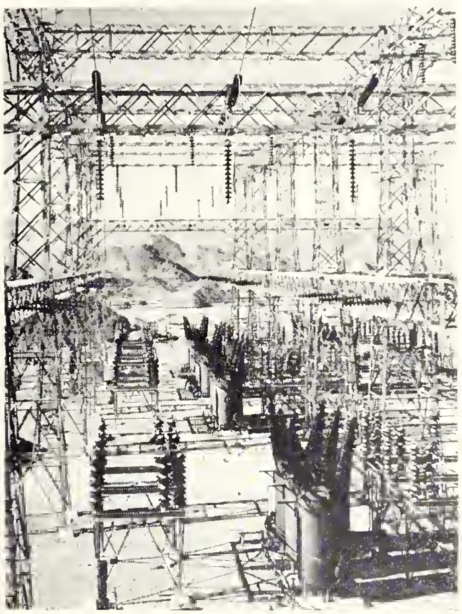
His signal, spanning a 2,700-mile remote control Western Union hookup to start the generator, was witnessed by congressional delegations from Arizona, California, and Nevada. The key, a special gold-plated instrument, was borrowed from the White House for the occasion.

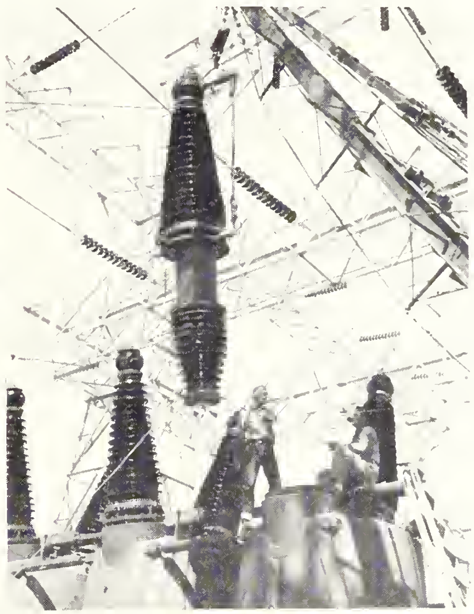
The official start of the generator was preceded by a message sent over the same wire from Secretary Chapman which stated in part, "I am happy to extend greetings to the people of the Pacific Southwest on this important occasion . . . The Lower Colorado River development is a shining example of what a free democracy can accomplish in utilizing the national resources for the benefit of its people. It is particularly pleasing that this major link of the development is going into operation in time for the power to be used as the Nation girds itself for freedom from aggression."

the benefit of farms in this country and Mexico.

The treaty with Mexico required that a dam be built in order to distribute a regulated delivery of 1,500,000 acre-feet of water annually apportioned to that country under terms of the treaty.

However, the story of the development of the whole Colorado River does not end with the completion of this dam. There are many other choice spots on the main stem and branches of the river *above* Hoover where other dams could be built—notably in Bridge, Glen, and Marble Canyons. Such dams could further regulate and conserve the river's water and energy, and their power plants could double the present output of hydroelectric energy on the lower Colorado. (For background information on Davis Dam, see previous issues of the RECLAMATION ERA for articles, How To Sidetrack a River, June 1946; Camp Life at Davis Dam, September 1946; Careers in Stone, July 1947; Detour at Davis, June 1948; Arthur Powell Davis, February 1950; and New Lake in the Desert, April 1950.) THE END.





FRAMED IN STEEL the stark Arizona mountains rise in the background behind this 230-kilovolt switchyard at Davis Dam above. Above right: Close-up of crane using special sling to transport bushing for oil circuit breaker. The last lap (at right) truck and trailer en route to Davis Dam to deliver 92-ton, 45,000 kilovolt ampere main power transformer for first generator. *All photos for this article by Phil Blew, Region 3 photographer.*

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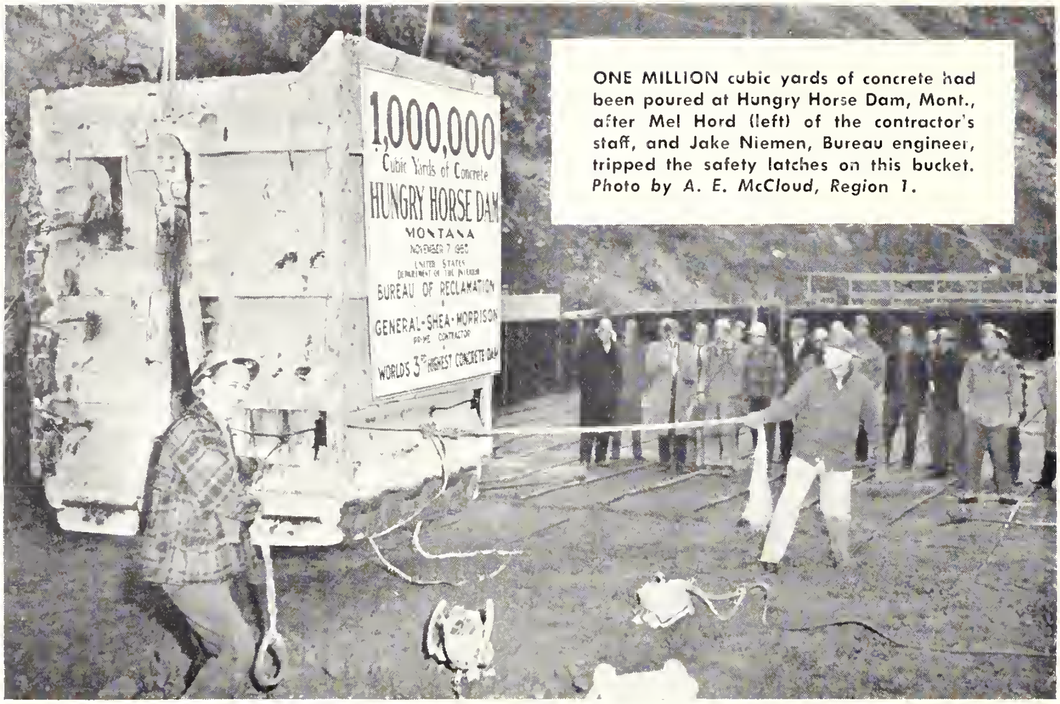


ONE MILLION cubic yards of concrete had been poured at Hungry Horse Dam, Mont., after Mel Hord (left) of the contractor's staff, and Jake Niemen, Bureau engineer, tripped the safety latches on this bucket. *Photo by A. E. McCloud, Region 1.*

Hungry Horse's First Million

MEETING THE CHALLENGE of a tight construction schedule, construction crews at Hungry Horse Dam in northwestern Montana won their race against time and the elements with placement of the millionth cubic yard of concrete at 4:30 p. m., November 7, 1950.

The race to meet the 1950 construction goal at the big multiple-purpose dam and power plant being constructed by the Bureau of Reclamation on the south fork of the Flathead River ended in practically a photo-finish with old man winter. On November 8, just a day after the millionth cubic yard of concrete was placed, winter's paralyzing cold halted major concrete operations for the year.

But with achievement of the year's objective in sight, the concrete crews wound up the construction season in a blaze of glory. Continuing their work at top speed through the brief ceremony held in observance of the important milestone in Hungry Horse construction, the crews set a new 24-hour record of 7,172 cubic yards during the period from 8 a. m., November 7, to 8 a. m., November 8.

Gathered for the ceremonies, a small group of Flathead Valley civic officials stood on the wet concrete of the dam and watched the bucket containing the millionth cubic yard of concrete swing out from the mixing plant high on the canyon wall and drop swiftly toward the blocks of the dam shrouded in the gathering shadows. Many of those present were representatives of civic organizations that had worked and fought to secure authorization of the Hungry Horse project.

The November 7 celebration was a happy climax to a driving finish in the 1950 construction race. Off to a slow start last spring, with crews using jackhammers to chip foot-thick ice from the blocks of the dam, the job gradually gained speed, and progressed at a driving pace through the summer.

On October 1, there were 788,000 yards of concrete in place, and some of the smart money said the boys could not make the million-cubic-yard goal before mid-November at the best. And the forecasters predicted that old-man winter would throw an ice and snow barrier across the track and stop the race before the finish.

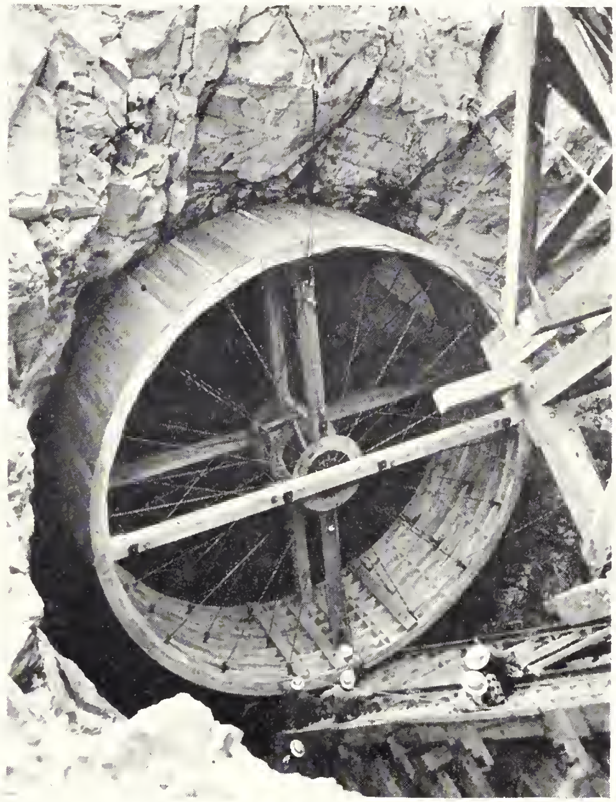
But the concrete crews put on a rousing stretch drive to break all monthly placement records with an October total of 184,000 cubic yards to boost the total concrete in place on November 1 to 972,000 cubic yards.

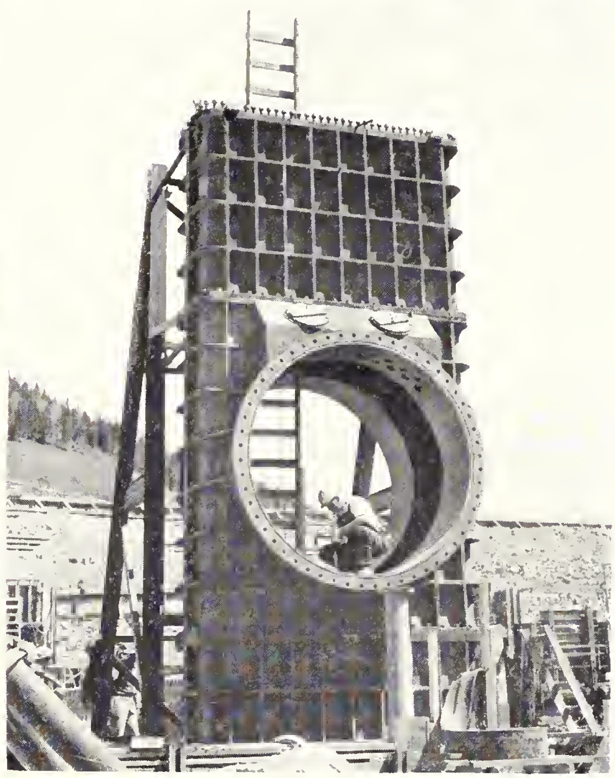
Continuing the fast pace during the first week of November, the construction crews passed the million-yard mark at 4:30 p. m., November 7.

Because of its importance as one of the major power and flood control projects in the Bureau of Reclamation's region-wide program for multiple-purpose development of water resources in the Columbia River Basin, Hungry Horse Dam has been given a top construction priority. With the 1950 program accomplished, engineers for the Bureau and General-Shea-Morrison, prime contractor for the dam and power plant, are already laying plans for an even tighter construction schedule in 1951. Major work scheduled for 1951 includes placement of an additional 1,200,000 cubic yards of concrete and start of installation of the first two 105,000 horsepower turbines.

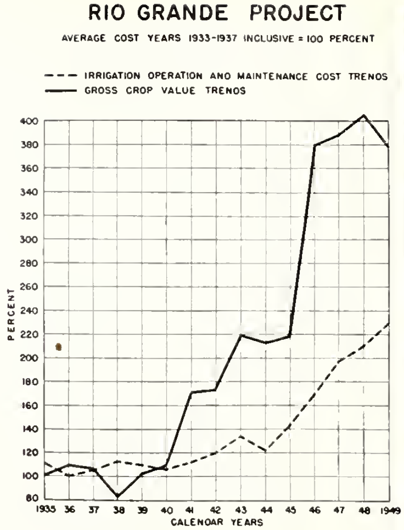
Under the present construction schedule, 1,000,000 acre-feet of water will be stored behind Hungry Horse Dam during the 1952 spring run-off. With the first two generators scheduled to go on the line in October and December of that year, this storage will make it possible for the Hungry Horse power plant to turn out approximately 90,000 kilowatts of power to help alleviate power shortage conditions in the Pacific Northwest during the 1952–53 winter peak load period. This storage also will firm up power output during the winter peak at downstream plants in Montana and on the Columbia River. THE END.

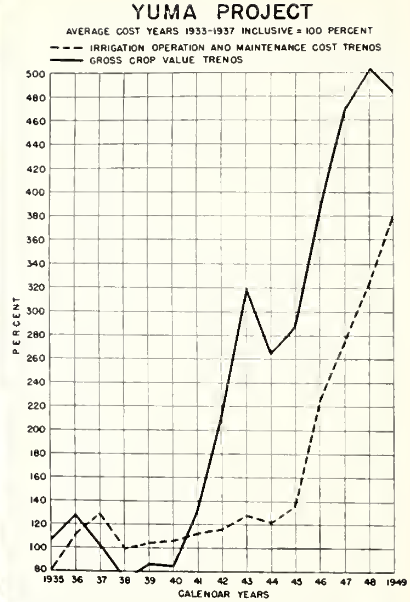
FERRIS-WHEEL form, man-made "geysers," and follower gates. ***Photos by A. E. McCloud and A. G. Rainwater, of Region 1.***





TWO TYPICAL Reclamation projects where operation and maintenance costs are way below the increased crop values, despite rising costs in practically every other item such as transportation, machinery, supplies, equipment, and labor.





O & M COSTS

"It's not the initial cost, it's the upkeep!"

How many times have you heard those words spoken? If you had been at the annual Operation and Maintenance Conference at El Paso, Tex., during the week of December 4–9, 1950, you would have heard references to the second topic frequently, although instead of upkeep the word most often used was O & M which of course means operation and maintenance to those familiar with the Bureau of Reclamation's vernacular.

Very few people took part in the conference this year, in order to save expenses. Less than two dozen carefully selected men, each a specialist in his own field, attended. In conformance with Commissioner of Reclamation Michael W. Straus' views, the hand-picked group concentrated on specific means for improving the work of the Bureau, with the accent on economical project operations and reimbursing the Government for the costs of irrigation construction. Never during the conference, therefore, could you have heard the first part of the quotation above. "It's not the initial cost." Nowadays the initial cost is a matter of grave concern, involving rising construction charges, labor and materials shortages, expensive delays, and many other problems.

However, the "upkeep" topic was foremost in discussions. The first thing, of course, was to determine how much O & M costs had risen. You may or may not be surprised to learn that in the last 8 years, irrigation farmers on Bureau projects have been getting high-quality service on both Bureau and water-user operated Reclamation projects at prices that have risen less than the prices of many other services. Generally O & M costs have risen less than construction costs, and have not risen along with crop prices. O & M increases

SERVICE IS THE WATCHWORD—The "before and after" pictures below illustrate one of the Bureau's functions on the Yuma project. Cleaning ditches is an important upkeep item, and on more and more projects the Bureau is saving money for the water users by using chemicals to accomplish this purpose rather than the mechanical method shown. *Photos by S. B. Watkins, Region 3.*

having been substantially less than those in crop values. Although water charges are now taking proportionally less of the water user's dollar, the conferees recognized there is room for improvement and increased efficiency in many project operations, particularly in view of the uncertain international situation. Extended periods of national emergency have always demanded increased crop production in the face of rising production costs. Unfortunately for the older Bureau projects, rehabilitation and betterment programs are only making a dent in the need for making up the set-backs of the last war and the preceding depression.

During the conference, the 20 men emphasized high standards of service and maintenance to get the most out of every dollar spent. On operating projects, particularly those operated by the Bureau, there are many items of costs which are beyond the Bureau's control. Higher wage and salary rates, the 40-hour week (a particularly vexatious problem when considering gatetenders, ditchriders, watermasters and project managers) and portal-to-portal working hours, necessarily increase expenditures for labor and supervision. Higher costs of supplies and equipment similarly are a major uncontrollable factor. In both categories, the diligence and resourcefulness of operating personnel are put to test. With generally rising costs for labor, materials, and equipment, increased efficiency and productivity per man-hour and per machine-hour are needed to avoid an excessive rise in water charges.

One of the most troublesome items is the cost of "overhead"—administrative and facilitating services. Although rarely a major factor in rising O&M costs, the conferees recognized that it is particularly objectionable to water users because in some cases administrative costs have risen more rapidly than the other items of project costs. Some of these costs, also, are not within the control of the Bureau, and those attending the O&M conference went over all Federal administrative requirements, both those established by the Bureau of Reclamation and those imposed by higher authorities such as the Congress, the Bureau of the Budget, General Accounting Office, and the Civil Service Commission. All of these requirements, to greater or lesser degree, increase O&M costs without comparable increase in service to the water users. Some, but not all, of these requirements are lifted when water users assume project operation and maintenance. The conference developed recommendations to accelerate such transfers in order to lift the burden of these administrative and facilitative requirements from the shoulders of the water users. This would give the water users control of water service and maintenance work on their own projects.

The excellent record of the water users in negotiating amendatory repayment contracts helped pave the way for a number of recommendations at the conference to secure appropriate financial participation by water users on new projects. These recommendations were directed toward

(Please turn to page 41)

"THE MAN ON THE LAND . . ."

The following editorial appeared in the Yakima Wash., Sunday Herald, November 19, 1950. We are reprinting it here as a matter of interest to our readers.

We find it difficult to settle on a theme for comment upon the National Reclamation Association's convention, which comes to a close this week end in Spokane. The organization seems to be riddled with disagreements and controversies as to what its members think about beneficial, future reclamation policy. Or perhaps one might say that the NRA is going through a wholesome phase of adjustment out of which new and more progressive courses of action will emerge. That is the way political parties usually pass off their civil wars. . . .

There is, however, one aspect to the controversies over reclamation which we regret, and which we think is unnecessary: It is the implied discord between the farmers and the construction and operating personnel of the United States Bureau of Reclamation. We say no ill feeling exists between the man on the land and the resident, district, or regional bureau employees. They have, for many years, enjoyed pleasant relationships. And we would make the further observation that the average water user on the great Yakima project—which is one of the largest in the world—has no serious complaint against existing reclamation policies, either on ownership of basic facilities, or on construction or on operation and maintenance. If conditions of violent discontent and resentment exist between the farmers and the Bureau of Reclamation in this great area of proven projects, we are not aware of them . . . ●

ALL EYES ON WIND RIVER

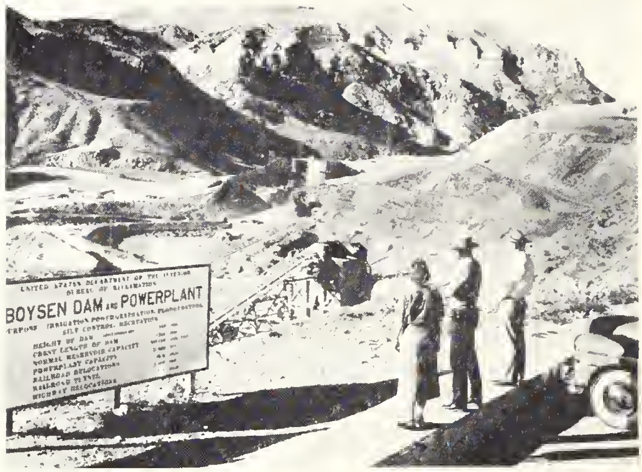
Part One—PLANNING THE PILOT STUDY

Prepared with the cooperation of W. G. SLOAN, chairman of the Interior Missouri Basin Field Committee, and based upon material submitted by R. D. NIELSON, Bureau of Land Management, chairman of the subcommittee on Wind River Investigations.

"Actions speak louder than words."

In accordance with this old adage, within a river basin in Wyoming, people are preparing a resounding reply to the question, "How can local, State, and Federal agencies work together in developing a river basin's resources with a minimum of fuss and feathers and to the maximum advantage of the people in the area?"

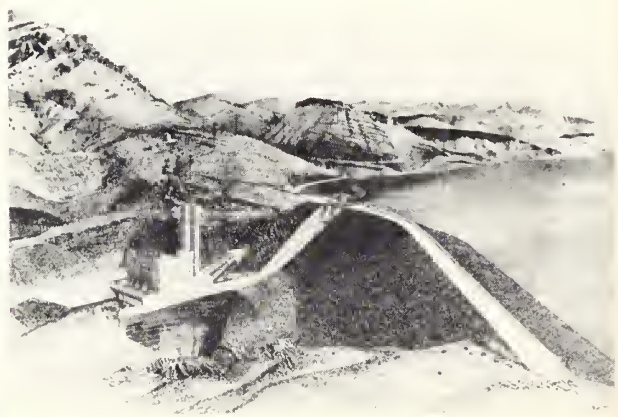
It all began in November 1947. W. G. Sloan, chairman of the Interior Missouri Basin Field Committee, had called a meeting at Riverton, Wyo. He pointed out the critical silt and erosion situation within Wyoming's Wind River Basin. Irrigation at the Bureau of Reclamation's Riverton project, and the Wind River Indian Reservation had not helped the situation any. In fact, irrigation was partly blamed for the increase in erosion and siltation. In addition, the Bureau of Reclamation had started to build Boysen Dam



BUILDING BOYSEN—An important key to the development of the Wind River Basin. *Photo by T. R. Broderick, Region 6.*

and the engineers were much concerned about its future "take" in silt; 260,000 acre-feet had been provided for silt accumulation space. The Big Horn River is an energetic silt carrier, but actual data to judge the adequacy of this storage reserve was not available. The silt situation was reportedly getting worse instead of better. So was erosion.

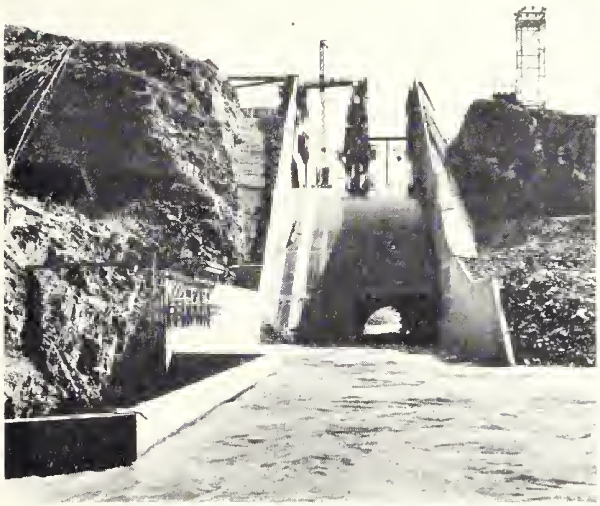
During the discussions, Chairman Sloan pointed out that 90 percent of the Wind River Basin's area was under the jurisdiction of the Federal Government. Federal agencies had been working together effectively for several years on the wide-scale development of the 10-State (Colorado, Iowa, Kansas, Minnesota, Missouri, Mon-

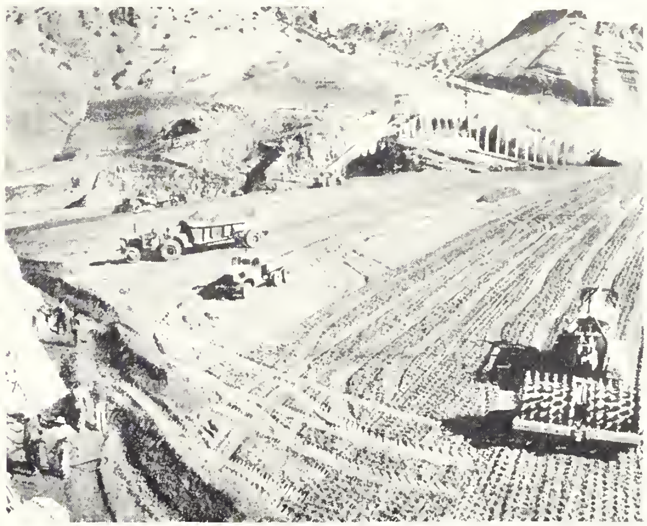


RAMPAGING RIVER creates scenes like Five Mile Creek area shown at left. REMEDIAL MEANS—Artist's conception of Boysen Dam and power plant above by M. H. Willson.

tana, Nebraska, North Dakota, South Dakota, and Wyoming) Missouri Basin program and had devised many methods of pooling "know-how," equipment, and personnel to good advantage. The problems cropping up in the Wind River Basin are not peculiar to that region alone. Here was a made-to-order opportunity to demonstrate how all the people and agencies concerned could solve these problems: putting water on land where it would do the most good; keeping it from damaging the soil; protecting fish and game, livestock, and forests; developing mineral resources, and encouraging community and industrial development. Wholehearted cooperation would be certain over 90 percent of the area, at least. So the Wind River Basin was selected as the "proving ground" or, as it came to be called, a "pilot study" to point the way toward successful river basin development. According to Webster, a pilot is "a guide, a director or leader of another or others, through a difficult or unknown course." And that is exactly what the Wind River investigations prove to be.

The Wind River Basin, with an area of about 5,000,000 acres (8,000 square miles) represents approximately $1\frac{1}{2}$ percent of the Missouri River Basin's total area of 338,560,000 acres or 529,000 square miles. Besides standing as a miniature model of what can happen to a river basin under intensive coordinated development, the Wind River pilot study will furnish valuable "do's" and "don'ts" for the people who will face similar problems in the entire Missouri River Basin and other areas.





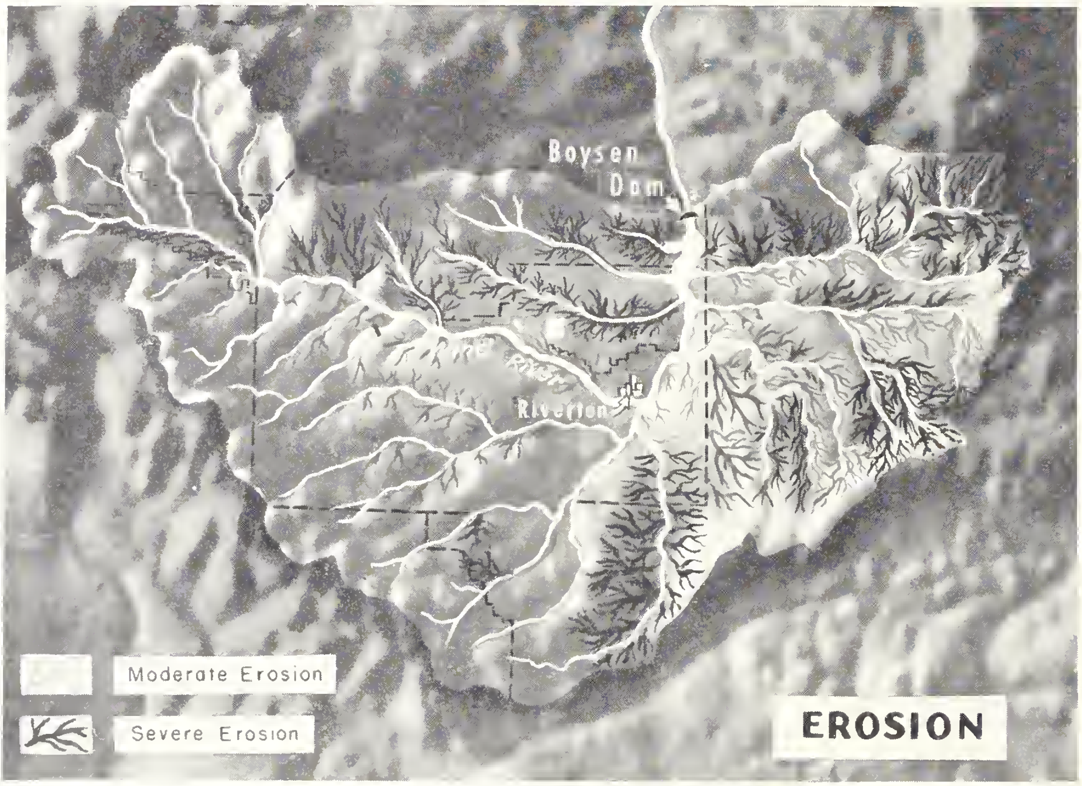
SPILLWAY SHAPES UP—Construction progress shown on Boysen Dam spillway at left. BIG GUNS—The compacting and earth hauling equipment at right is stepping up the eventual water supply for 20,000 acres of land. *Photos by T. R. Broderick.*

The first job was to get a general idea of the area as a whole, figure out what had to be done first, and find people who would do it. Three months after the Wind River investigations were suggested, the subcommittee which drew the assignment for the preliminary study presented an outline to the Field Committee at its monthly meeting at Lincoln, Nebr. This was approved and on April 20, 1948, the chairman of the subcommittee, R. D. Nielson of the Bureau of Land Management, with Ralph H. Workinger of the Bureau of Reclamation, and J. D. Lamont, Bureau of Indian Affairs (the other members of the Wind River Basin subcommittee) submitted a report to the Interior Missouri Basin Field Committee at its regular meeting at Billings, Mont.

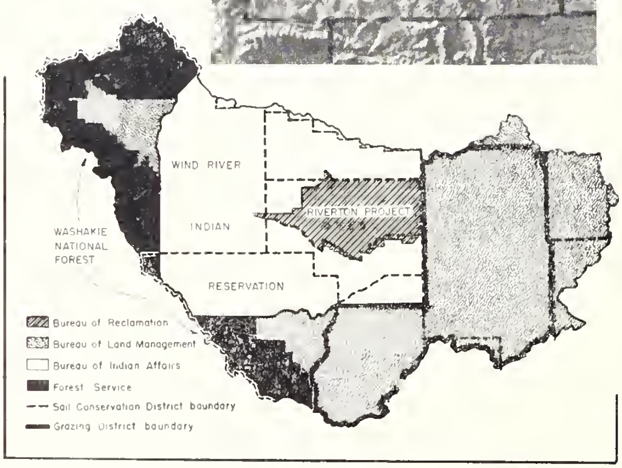
They had obtained a general description of the area, its resources and economy, an account of the resource development program in the Wind River Basin, a résumé of the interests of Interior Department agencies in the basin, with a summary of the work each agency was prepared to do, and had found out which agencies outside the Interior Department were interested and could participate in the pilot study. The subcommittee also had worked out a tentative time table of investigations needed to develop the Wind River's resources and solve the most critical problems.

Here is a summary of their general description of Wind River Basin.

THE BASIN TODAY



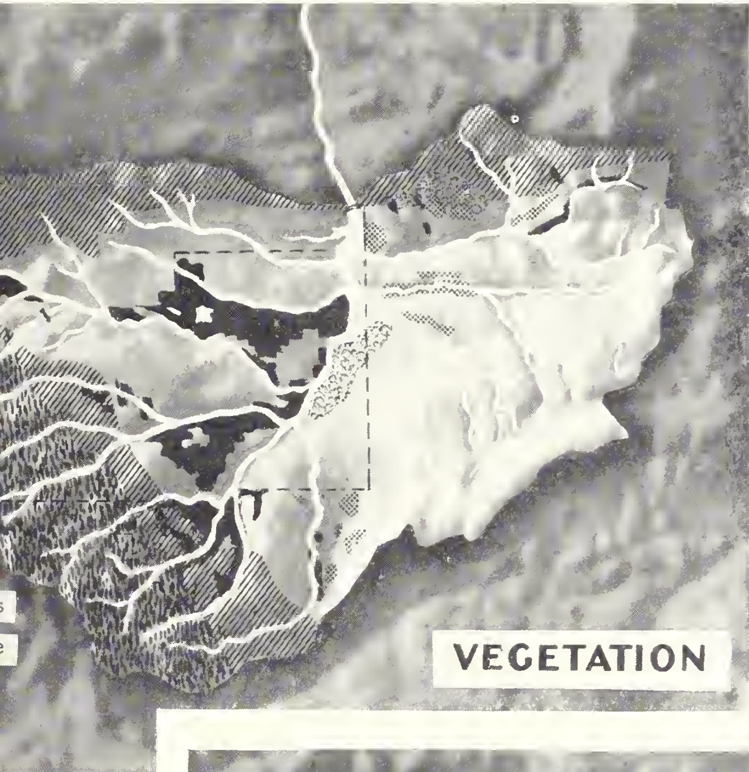
CLOSE-UP AND LONGSHOT of Wind River Basin in Old Wyoming. *Prepared by Graphics Section, Washington, D. C., office of Bureau of Reclamation.*



The Wind River area is unique in many ways. It has a wide range of weather, soils, minerals, forests, fish and wildlife, water and land use problems, and agricultural, industrial, and recreational possibilities. It lies at the very headwaters of one of the principal drainages of the Missouri River. The Wind River becomes the Big Horn River a few miles above Boysen Reservoir where the Wind and Popo Agie rivers join, and beyond the Big Horn Basin joins the Yellowstone River on its way to the big Missouri.

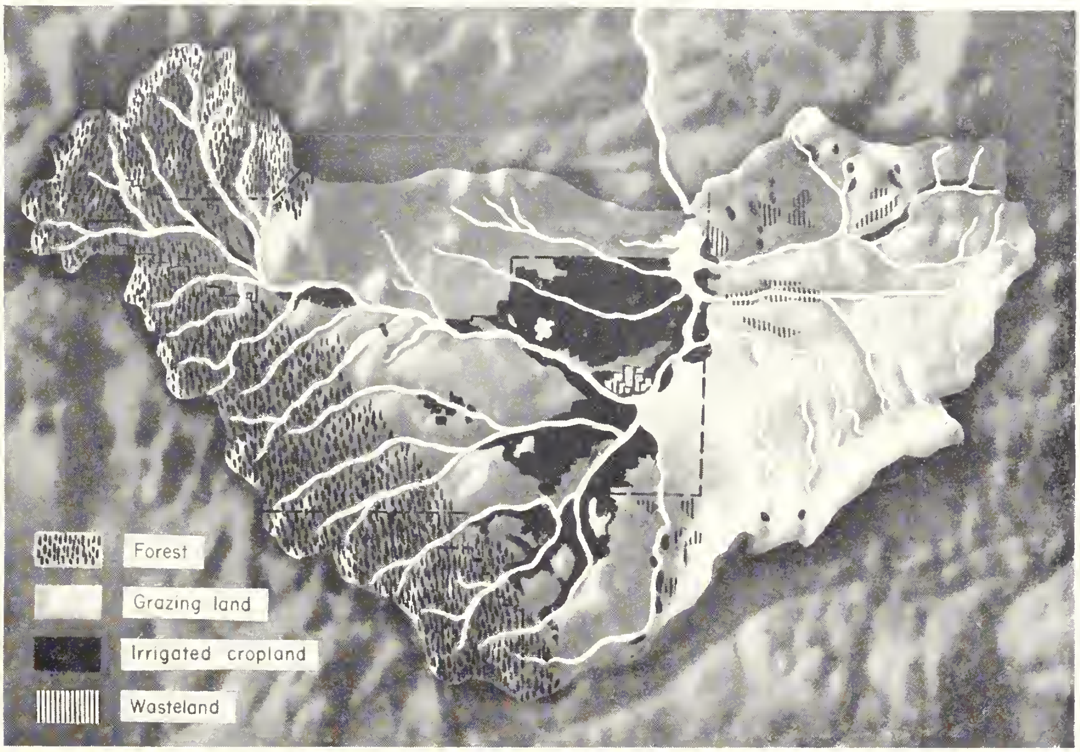
Land ownership and control of the area is as follows:

	Acres
Indian reservation lands under the jurisdiction of the Bureau of Indian Affairs	2,018,000
Public domain under the jurisdiction of the Bureau of Land Management	1,344,000
National forest lands administered by the Department of Agriculture	830,000
Lands embraced within Reclamation withdrawal yet unpatented	160,000
State-owned lands	210,000
Privately owned lands	500,000
Total	5,062,000



NOW, AND WHAT COULD BE—The two maps at left show the present status of the Wind River Basin, while the one below shows the changes which can be made. Note at present the severe erosion trends and the limited and sparse vegetation in the area. However, with the cooperation of the various Federal agencies, irrigated acreages could be increased, wastelands could be reclaimed, seeded, and used for grazing, and a stepped-up all-out war on erosion would give the whole basin a face-lifting as shown below.

Illustrations for Wind River adapted from information supplied by the Bureau of Reclamation, Bureau of Land Management, Indian Service, and Forest Service.



POTENTIAL LAND USE

This patchwork-quilt-like division of the Wind River Basin under various ownerships is overlaid with soil conservation district boundaries, and grazing boundaries, in addition to various overlapping township and county areas, as well as tracts of land which are of definite concern to other Federal agencies and private interests.

The problem to be solved in the Wind River Basin is to use the land and water in such a way that it will provide the greatest benefit to the greatest number of people.

In 1940 there were 16,000 people living in the Wind River Basin, who depended on the soil and water resources for their livelihood. About 90 percent of the land in the basin is used for grazing. Farm crops and timber are the other principal sources of income, although petroleum resources are coming into the economic picture more and more.

Some of the grazing areas also support some timber and are significant as watersheds. According to livestock figures, there are about 190,000 sheep and 45,000 cattle which are primarily dependent on the basin as their principal pasture. Successful livestock production depends on both natural range and forage crops, as the climate limits the period during which the stock can be turned out to pasture. Farm crop production is practical only under irrigation. In 1947, crops from 9,913 acres of farm land within the Indian reservation were valued at $294,613. In the same year 38,600 acres of irrigated lands under the Riverton project produced crops valued at $2,360,849.

Coal is mined near Hudson, mostly for local use. Gas and oil are important industrially, and much crude oil and gas is piped and shipped to Casper for refining. In 1948 the Wind River Basin produced 12.9 billion cubic feet of gas and 9 million barrels of oil. Other minerals in the area include phosphate rock—a potentially important undeveloped resource—considerable gypsum deposits, and some asbestos, tungsten, mica, tantalite, and gold.

Lumbering is a significant industry of the area, railroad ties being the principal product. Power line poles are also produced in quantity, and there are a few small lumber mills in the Basin.

The Wind River Basin has some of the best fishing and hunting in the West. In the western portion of the basin, dude ranching is a flourishing business, and tourists provide a considerable income to the area. Outdoor sports include fishing, hunting, hiking, camping, and other recreational activities.

Wind River is served by two railroad lines and transcontinental highways.

This thumbnail sketch of the Wind River Basin may give you an idea of the interlocking pieces of the puzzle. Anything that is done to reclaim and irrigate arid lands will have an immediate repercussion on farm production, livestock raising, mining, lumbering, and vacationing. Similarly, when hydroelectric power is produced, farms, ranges, forests, mines, dude ranches, tourist spots, and industries will be affected.

Most of the water supply comes from the higher elevations in the national forest and the Wind River reservation. Management, protection and improvement of watershed areas here and elsewhere cannot help but have an effect upon other areas. Soil erosion, siltation, water yields, forage production, timber production, wildlife, and recreational uses must all be taken into account when planning a comprehensive development program.

Interior Department agencies participating in the plan include the Bureau of Reclamation, the Bureau of Indian Affairs, the Bureau of Land Management, the United States Geological Survey, the Fish and Wildlife Service, the National Park Service, and the Bureau of Mines. The United States Department of Agriculture's Forest Service, Soil Conservation Service, Production and Marketing Administration, and State Extension Service have important parts in the program, as do the Weather Bureau of the Department of Commerce and many State and local interests.

Priority numbers were given to designated items in the program. They were not hard-and-fast schedules, however, as everyone realized that a certain amount of juggling might be necessary as the pieces of the jigsaw puzzle began to fit together. Some programs might progress faster than anticipated, and unexpected delays would also require adjustment.

The Bureau of Land Management literally got in on the ground floor. The first thing that was needed was to take a complete inventory of the land and its surface resources.

Bureau of Land Management crews, composed of experienced land classifiers, men who know

(Please turn to page 40)

Taming the Tamarisk (Salt Cedar)

SALT CEDAR silently begins to spread like a thief in the night, above. At center, invading McMillian Reservoir, Carlsbad project. At right, salt grass invading dead salt cedar. *All photos by Fred S. Finch, Region 5.*

by JOHN H. KOOGLER and O. J. LOWRY, Conservationists (Public Lands), Region 5, headquarters at Amarillo Tex.

THEY ARE GANGING UP ON SALT CEDAR down here in the Southwest. By "they" we mean the Soil Conservation Service, the Army's Corps of Engineers, and Interior Department's Fish and Wildlife Service, Bureau of Indian Affairs, Bureau of Land Management, and last, but not least of course, the Bureau of Reclamation.

Why all this concentration on a beautiful, decorative shrub, often 15 feet tall, each full-grown plant faintly resembling a dozen closely packed Christmas trees? Before we answer this question, let us make it quite clear that we do not mean the tall evergreen cedar, widely planted in the Southwest as a shade tree whose proper name is the athol (tamarix aphylla), and never becomes a pest, but the shrub species of the tamarisk, called salt cedar—not an evergreen, but deciduous—shedding its leaves in the fall, the most common species being tamarix gallica.

This latter shrub, a native of the Mediterranean region, appeared rather mysteriously in the western United States many decades ago, and within the last half century has invaded southwestern valley grasslands, river channels, floodways and reservoir deltas with devastating effects. Ecologists (scientists who make a particular study of plants and their growing habits) have a surprisingly meager supply of information about the salt cedar and how to control or destroy it. And destroyed it must be. Today salt cedar has completely taken over large areas on the Pecos River and the Rio Grande in New Mexico and the Red River in Oklahoma.

In 1940 the National Resources Planning Board estimated that the 14,000 acres (count them—14,000 acres) of salt cedar in the McMillan Reservoir Delta above the Carlsbad irrigation project in New Mexico consumed 54,000 acre-feet of water each year. At that rate, the salt cedar gobbles up almost half as much water as the Carlsbad project farmers use to irrigate their 25,000 acres of productive land.

Salt cedar grew so thick and fast in the McMillan Reservoir Delta that in 1948 project officials had to hack away at the shrubs and dig a channel almost 5 miles long through the salt cedar area so irrigation releases and low flood flows could find their way through to Lake McMillan.

On the 155,000-acre Rio Grande project in New Mexico and Texas, the farmers use about 730,000 acre-feet of water each year to irrigate their crops. Reclamation engineers believe that salt cedar in the river bed and on uncultivated areas above the Rio Grande project's storage reservoirs swallows 240,000 acre-feet of water each year, or more than one-third of all the water used annually for irrigation.

These are specific examples of the ravages of salt cedar and the damage it has done on Bureau projects. Other agencies have been gathering other incriminating data regarding this pest. Salt cedar takes over land which should be producing crops and pasture or furnishing food for wildlife. In the flat terrain typical of the Southwest, where the rivers meander along their un-

charted courses, salt cedar becomes extremely dangerous at flood time. Dense growths of the pest can block the flood waters and spread them over the surrounding countryside; debris piles against the shrubs adding to the strength of the temporary blockade, and as a result roads, railroad tracks, towns, and ranches have been inundated—all because of the untamed tamarisk.

You can readily understand why there has been a surge of interest in this shrub, especially in view of recently aggravated water shortages throughout the United States, and the emphasis on soil and water conservation.

We in the Bureau of Reclamation started the Carlsbad Salt Cedar Control and Water Conservation project in 1948, and for obvious reasons selected McMillan Reservoir Delta as our outdoor laboratory. The studies were paid for out of soil and moisture, Carlsbad project, and general investigation funds.

First we tried an air-attack, spraying 200 acres of growing salt cedar from an airplane, using the then new hormone-type weed killer known as 2,4-D. Two weeks after the first treatment, we noticed the leaves were falling off the salt cedar. However, only a small percentage of the shrubs were actually killed.

The following June, we sprayed half of the original 200-acre test plot, spreading 2,4-D over the 100 acres from an airplane. This second application killed 85 percent of the salt cedar.

Between September 1948 and October 1950, we experimented with various mixtures and ran tests on 25 separate plots during the 2-year period. Our spray mixtures of sodium and amine salts of 2,4-D varied from 1,000 parts per million to 5,000 parts per million in 100 gallons of water. We obtained the most satisfactory results with two applications of 3,000 parts per million of 2,4-D in 100 gallons of water, spraying some plots from an airplane and others from a ground-spray rig. Both methods gave favorable results, airplane spraying having an advantage for areas where it is difficult to get ground-spray equipment to the site. We found airplane spraying to be the most practical way of killing salt cedar in stream beds or on ground that is being cleared for pasture, where dead brush does not have to be removed.

We contracted with a regular flying service for all of our airplane spraying, the Bureau furnishing the chemicals and the ground crew for mixing and loading. At present, we are unable to figure the costs of this operation as the short hops and special test sprays over small areas made the operation more expensive than it would have been for large-scale operations. However, the cost for spraying large areas of salt cedar should be about the same as for applying similar volumes of herbicide to field crops. Our airplane expenses ran about $6 an acre.

So far, we believe that salt cedar infested lands that are to be used for cultivated crops should be cleared with mechanical methods. Up to the present time, the cost of clearing and removing brush on the test plots have averaged $56 per acre.

Although the salt cedar control experiments are not scheduled to end until 1952, the information we have assembled since 1948 reveals the following facts:

1. Salt cedar can be killed with at least two sprayings of properly proportioned 2,4-D if applied to the foliage during the plant's growing season.
2. The cost of chemical control is less than the the cost of mechanical control.

We will not have final results on the program designed to solve the salt cedar problem and salvage irrigation water on the Carlsbad irrigation project until we have run tests through another two growing seasons. However, we are most encouraged with the results so for. Now that committees responsible for coordinating the development of river basins have formed salt cedar subcommittees, and other groups of agencies have banded together to help develop a comprehensive plan for salt cedar control, we believe we shall soon have the answer to the problem of halting the spreading growth of salt cedar, and taming the terrible tamarisk. THE END.

Chapman Issues Security Directive

Secretary of the Interior Oscar L. Chapman issued the following directive to the heads of all bureaus on December 21, 1950:

The President of the United States has proclaimed the existence of a national emergency. Pursuant thereto and implementing my memorandum of July 13 relative to protective measures to be taken in the event of an emergency, you are directed to take steps immediately to restrict access of the public except to authorized persons to those parts of the interiors of dams and power plants that are vulnerable to sabotage and to control access to all vital installations or parts thereof considered to be of critical importance to the security of the Nation. •

PLAIN TALK from KANSAS

A talk given at the City Hall, Stockton, Kans., before the Kansas Reclamation Association's annual meeting by Mrs. Curtis Fry, Webster, Kans., October 4th—10:30 a. m., 1950.

TRUE PIONEERS—Mr. and Mrs. Curtis Fry. *Photo by Ralph Williams, Region 7.*

I AM A DAUGHTER OF THIS SOLOMON VALLEY. My father and mother took up a homestead near the mouth of Lost Creek in 1877, and on April 1, 1878, they brought by covered wagon their few belongings and two small children and settled here.

This was home to them for the rest of their lifetime. They were honest, true, and sturdy pioneers who came to make a home in the wilderness and to derive a livelihood from the untamed prairies.

You, friends, as well as I, have heard some "nitwits" of today say, "Oh well, the Government gave them the land."

Folks, I can tell you what small part the Government gave to the pioneer of yesterday. It was a piece of paper, betting 160 acres of land that you couldn't live and make a home on it for five years. Many pioneers won that bet through toil, adversities, brain and brawn. Many pioneers gave that hard-won heritage to their loved ones down through the generations trusting in them to carry forth and develop God's plans for the benefit of mankind.

Today we see those intentions of the Divine Master being fulfilled, as was wont to be. I think it is safe to say there is no more worthy heritage than the Reclamation unit that today stands on solid footing. Its vast worth can never be measured in dollars and cents. It is a heritage that benefits humankind to the four corners of the earth, not just the United States alone, but to every human being in the world.

Irrigation in rich valleys of soil and sunshine will feed the teeming millions of other places less fortunate. It is up to man to carry out God's will and intentions. Within the mind and human heart of man, He has placed the seed of desire, determination and effort to try hard to do so. On these grounds the Bureau of Reclamation has been founded, and in this spirit its endeavors are going forward with success.

Everything accomplished in this world is through effort, strife, and determination, and we find many worthwhile causes are thrown by the wayside through timidity, through pressure from groups, or from want of help—honest-to-goodness help. However, we begin to think of the pressure on High working through the elements of Nature, which wash our soil away to the far off sea by devastating floods, which sear by drought the sands of rivers, ponds, and creeks of water making them fit for neither man, nor beast, nor bird. How the thoughts flew to my mind of the great place close by, and other places too, that nature had so made and helped to win half the battle, and then cried out to man for help.

When we were children, my sister and I would drive our cattle to the river close by and take shovels to dig holes in the sands for water, making little mounds here and there. We would dam up the water for another day. Then the thought came to me, if we only had help, wouldn't it be wonderful if we could dam up this stream? Today we are well on the way to materialize that dream of long ago, and we heartily thank the help from the higher channels to bring forth this great cause. Especially do we thank our local Directors, Carl Brown and Irl Gilliland, for their willingness and ability during these many years to carry through this issue to a successful conclusion. We thank everyone who has helped in any way, and there have been many indeed, who furthered this worthy cause that will be a blessing to mankind, and who contributed to the rightful development and good of this, the heart of the Nation, for generations to come.

THE END.

TOO LATE to make the December 1950 story, "Superior-Courtland Dedication," but too good a photo to omit, here are District Manager H. E. Robinson, Miss Republican Valley, Killie Sprage of Red Cloud, Nebr., Regional Director Avery A. Batson of Region 7, and Paul Strouse, Chief Engineer of the Bostwick Unit. Photo by Lyle Axthelm, Region 7.

Straus and McClellan Attend International Conferences

Reclamation Commissioner Michael W. Straus, and Chief Engineer L. N. McClellan left the United States on December 26, 1950, to attend a series of international water resources conferences in India scheduled for early January 1951.

They attended the conferences in the land of the world's largest irrigated acreage as two members of a 14-man United States delegation. Officials of the Bureau of Reclamation and members of the Indian Government have been exchanging technical irrigation service for a long period of time and this visit is expected to cement relations between the two countries.

In addition to the Indian mission, Mr. Straus was scheduled to discuss a number of special ECA, Point Four, and other technical matters with officials in other countries including Italy, Israel, Pakistan, Ceylon, the Philippine Islands, and Guam.

He was to serve both as a member of the United States Executive Committee of the World Power Conference in the American delegation, and as a member of the executive committee of the International Congress on Large Dams during the sectional meeting of the conference in New Delhi January 10 to 15. Mr. Straus was to present a paper entitled "Water and Power in Our World," while Mr. McClellan was to speak on "Feasibility of Irrigation Projects Increased by Development of Hydroelectric Power."

Mr. McClellan attended the meeting of the International Association of Hydraulic Research in Bombay January 3 to 5, and the United Nation's Economic and Social Council's Technical Conference on Flood Control held in New Delhi January 7 to 9. ●

All Eyes on Wind River

(Continued from page 36)

(among many other things) about soils, grass, erosion, and the carrying capacity of range lands, or in other words, how much livestock can graze on certain types of vegetation, combed the 1,000,000 or so acres of public land in the Wind River Basin, to see what its condition was at the time, and what use could best be made of it. Fortunately most of the area had already been surveyed and corners established. The crews took their plane tables outdoors, and from aerial photos, topographic maps, cadastral surveys and other data, sketched out rough maps, filling elaborate work sheets with information about the type of vegetation, its density, the types of grasses, shrubs, type and seriousness of erosion, type of surface soil, whether it were sandy, stony, rocky, until practically every inch of ground could be described accurately. From these data, they prepared extremely detailed maps, from which

the illustrations on pages 34 and 35 were designed, showing the condition of the land at the time of the survey, and how to make the most of it.

Practically the same work went on in the Indian lands and Reclamation project. From these data, the people working on the pilot study saw what had to be done first, and they set out to do it.

(Next Month: Working on Wind River)

Blast the Silt

(Continued from page 25)

a menace. You will notice a block of silt about 2 feet wide, reaching across the pool, left immediately upstream from the weir blade. You will have to remove this silt with a shovel, but as the experiments proved, this residue is insurance against damage during the blasting.

In the accompanying illustrations, the pool was about 30 feet long and maintenance man Hoshaw used 20 half-pound sticks of dynamite. The blast left the pool about 6 feet wide and 2 to 3 feet deep. In less than an hour, one man plus 10 pounds of dynamite excavated and disposed of nearly 20 cubic yards of material.

You might have to modify the procedure somewhat to get the best results on your particular farm, but we think it is worth a try. The End.

Canadian River Project OK'D by President

In the closing days of the Eighty-first Congress President Truman signed the Candian River bill authorizing construction of the Canadian River project in northwest Texas by the Bureau of Reclamation. This development will permit 11 cities in the area to receive additional water supplies badly needed for municipal, industrial, and irrigation uses.

Actual construction is dependent upon the ratification of a compact between the States of New Mexico, Texas, and Oklahoma by the Congress concerning the division of waters and the specific appropriation of funds by Congress for the necessary work. This latter must be considered in light of the over-all needs of the defense program.

The 11 cities which can benefit from the legislation are Amarillo, Tahoka, O'Donnell, Lamesa, Salton, Levelland, Pampa, Borger, Plainview, Lubbock, and Littlefield, all in Texas. •

Neilsen Named Assistant Director in Region 3

Edwin G. Neilsen, regional planning engineer in the Bureau's Region 3 at Boulder City, Nev., has been named assistant regional director for that region. He succeeds L. R. Douglass who was recently promoted to the position of director of power at the Boulder Canyon project.

Mr. Neilsen, an engineer with more than 23 years experience, began his professional career with private companies in 1927. He served as assistant engineer with the Public Service Co. of Missouri from 1931 to 1933 and joined the Bureau of Reclamation as assistant engineer in Denver, Colo., during 1934. He was subsequently promoted to associate engineer and later made engineer at the Bureau's Salt Lake City office. Before coming to Boulder City he was the chief of the hydrologic division in the Bureau's Denver Office.

He received his degree of BS from the State University of Iowa. •

O & M Costs

(Continued from page 31)

establishing payments on a current income basis by the use of suitable annual variations which are geared to the productivity of the farms and by making certain that land owners who vote in the contract elections are fully informed of Bureau of Reclamation requirements.

The report and recommendations of the conferees are designed to lead to further action. Some actions are within existing authority of regional and project heads; some actions will require approval by the Commissioner, the Secretary, or the Congress. Regional and Washington Operation and Maintenance Branch representatives will take appropriate steps to give effect to the conference recommendations so the water users will get what they pay for, and a little bit more. The End.

WATER REPORT

Taking a sweeping glance at Reclamation reservoirs at the beginning of the new year, we see a great contrast—full reservoirs in the Northwest, overflowing reservoirs in California and Nevada, and almost empty reservoirs in the Southwest.

A warm and wet December filled reservoirs in the Columbia Basin well above normal. December floods in California and Nevada, although not reaching the peak flows of November, were heavy enough so some of the water was released to provide storage for future flows and to prevent uncontrolled spilling. Arizona streams barely trickled into the Salt River project's reservoirs, and the runoff of the Salt River above Roosevelt Dam was reported to be the lowest ever recorded in December since the records began in 1913. The flow of the Rio Grande into Elephant Butte Reservoir was less than half its normal amount, and no stored water is being released for winter irrigation.

Here is a closeup of the water storage situation, region by region (see map on back cover to locate areas):

REGION 1—most reservoirs contain more stored water than normal for December, and on some projects water is being released to make room for spring runoff. Although more water than usual flowed into reservoirs of the Vale project in Oregon during December, the reservoirs are critically low for this time of year. Rains and melting snow over the weekend of December 23 swelled the amount of water stored in the Yakima River system.

REGION 2—all stream flow records for the period October 1 to December 31 on the Central Valley project were broken in 1950. At Shasta, 367,000 acre-feet of water was released through the river outlet valves to increase the flood-control reserve, and 140,000 acre-feet was released at Friant. The 140,000 acre-feet released in December was more water than it had in storage in December during the last 3 years. Although the water supply prospects for the next irrigation season are excellent, the snow pack in the Sierra Nevada was seriously depleted during the warm rains of November and December.

REGION 3—reservoirs on the Salt River project are stricken by the Southwest drought. Lake Roosevelt, with an active capacity of 1,398,400 acre-feet contained only about 2,400 acre-feet at the end of December. Salt River project people are taking advantage of the situation by rehabilitating Roosevelt Dam while the water is low. Heavy snows and rains on the watershed of the Salt and Gila rivers are critically needed to assure next season's crops. Looking on the brighter side of the picture, in spite of below normal precipitation in the upper portion of the Colorado River, Lake Mead has a large holdover storage to assure abundant irrigation water for 1951 crops.

REGION 4—in southwestern Colorado, very little snow was reported by the end of December in the drainage area above the Jackson Gulch Reservoir. On the other hand, water was released from reservoirs of the Truckee River Storage and Newlands projects during December to provide space for spring flows because of the California and Nevada floods.

REGION 5—except for the Rio Grande project, reservoirs contain enough water so project farmers should have ample irrigation supplies this year. Lower Parks Reservoir of the Balmorhea project in southwestern Texas has filled, and the Altus Reservoir of the W. C. Austin project in southwestern Oklahoma is nearly full. But on the Rio Grande project in New Mexico and Texas, storage hit a new low for December, with reservoirs storing less water then they have for 32 years during this season.

REGION 6—melting snows in the upper Missouri Basin filled reservoirs in northern Montana's Milk River project so they were above normal for the beginning of the year. A good snow cover in the St. Mary River Basin promised normal runoff. The Buffalo Bill Reservoir of the Shoshone project in Northern Wyoming was three-quarters full, the highest December storage since 1947.

REGION 7—all reservoirs contained favorable storage for the beginning of the year. The North Platte River brought a heavy flow of water, for December, into the Pathfinder Reservoir, probably because the mountain streams were not frozen over due to warm weather.

LETTERS

Louisiana Purchase

PORTALES, N. MEX.,
August 20, 1950.

DEAR EDITOR: I am renewing my subscription to RECLAMATION ERA, for 5 years, enclosed is $5 for same.

Please send the ERA to me at P. O. Box 247, *De Ridder*, Louisiana. (De Ridder) is two words.

I am going there to be in charge of the sprinkler irrigation for West Louisiana Experimental Farm which will be put in operation in Spring of 1951.

I enjoy the ERA very much and wish to keep abreast of developments in the West even though I will be in "Deep South."

Louisiana has an average rainfall of 49 inches per annum but in July and August they are plagued with drouths. It is believed that sprinkler irrigation will be justifiable so I am running a 5-year test to determine the practical application of same.

Respectfully yours,
PAUL E. WHITESELL.

Many thanks to Mr. Whitesell for his kind words, and also his 5-year subscription renewal. It is most gratifying to note the interest of people throughout the country in the reclamation program of the West. If Mr. Whitesell is so inclined, we are certain our readers would be most interested in learning the results of his 5-year test at the West Louisiana Experimental Farm, or any positive "do's and don'ts" which he discovers during the course of his investigations. May we hear more from Mr. Whitesell.—Ed.

RELEASES

New Mexico Coal Reserves More Than Adequate

New Mexico's coal reserves, recently appraised by the Geological Survey at 61 billion tons, are enough to serve the needs of that State and supply substantial amounts for export to California and Arizona. Convenient rail connections exist for transportation to both of these areas.

This supply is an important source of energy for the State's present needs and will contribute to the future industrialization of the West. By comparison, New Mexico ranks midway in the list of 24 States in the United States having major coal reserves. It exceeds Indiana and Oklahoma by a small amount and has slightly less reserve than Washington and Alabama.

In the more distant future New Mexico may have to depend on coal as a main source of energy, with the development of commercial processes for the synthetic production of liquid fuels from coal, and the underground gasification of coal (conversion of coal to gas) both of which are now in experimental stages.

Appraisals show that the reserve is made up of 50 billion tons of subbituminous coal in beds more than 30 inches thick, and nearly 11 billion tons of bituminous coal and small amounts of anthracite in beds more than 14 inches thick.

For complete information, a report titled "Coal Resources of New Mexico" by C. B. Read, R. T. Duffner, G. H. Wood, and A. D. Zapp may be obtained without cost by writing to the Geological Survey, Washington 25, D. C. ●

New Reclamation Pamphlet Available

A new illustrated pamphlet explaining the how, where, why, and when of Reclamation, including numerous statistics, was recently released by the Bureau of Reclamation. Copies may be obtained free by writing to the Bureau of Reclamation, Department of the Interior, Washington (25), D. C., or to any of the Bureau's regional offices. In your request, specify the title of the pamphlet, which is, appropriately enough, "Reclamation." ●

New Maps Available

Seven new project maps have recently been released by the Bureau of Reclamation, as follows: Bostwick Division, Missouri River Basin, Kans.-Nebr.; Cannonball Division, Missouri River Basin, N. Dak.; Montana Pumping Division (Nickwall Unit), Missouri River Basin, Mont.; Owl Creek Unit, Big Horn Basin Division, Missouri River Basin, Colo.-Wyo.; Newlands project, Nev., Rio Grande project, N. Mex.-Tex., and Shoshone project, Wyo. These maps are all in color, and available in two standard sizes, 10½ by 17 inches and 21 by 34 inches. Those who wish to obtain these maps, should send their requests to their nearest regional director (see directory on inside back cover of this issue), and specify the name and size of the maps desired. Single copies are free to those who have need of them in connection with their work or studies. ●

POSTSCRIPTS

IRRIGATION PAYS (In Spite of Rain)

James Barker, University of Nebraska Agricultural Extension Engineer in charge of the experimental work at the Anderson development farm near Arapahoe, Nebr., has released figures which show that irrigation in the Frenchman-Cambridge Division will pay off even in years of above-average rainfall. One corn test plot under irrigation on the farm yielded 152.3 bushels per acre. The irrigated corn on the farm averaged 125.8 bushels per acre, as compared with 89 bushels per acre for the nonirrigated corn. Irrigated alfalfa also paid off, Mr. Barker said. The maximum yield of irrigated alfalfa was 6.25 tons per acre, while the top yield of nonirrigated alfalfa was 3.77 tons per acre. ●

Thar's Gold in Californy—Water

During 1950 the United States Government, through the sale of water to irrigation districts, public utility districts, and municipalities, was paid $793,848 for 427,015 acre-feet of Central Valley project water. Preliminary estimates indicated an additional $38,500 in revenue would be earned by the close of the year. The gross CVP power revenues for 1950 total approximately $7,700,000. The grand total revenue from the sale of CVP water and hydroelectric power from Shasta and Keswick Dams, since the first water deliveries in 1940 and the first power generation in 1944, has already surpassed $34,000,000. Of that amount about $2,900,000 represents revenue from sale of project water. ●

Is That Enough?

Almost 40 percent of the land area of the United States receives too little rainfall for safe general agriculture, according to a Twentieth Century Fund survey, but only 3 percent of this area is now being irrigated. ●

Correction

In reprinting Public Law 451, regarding the Bureau's Rehabilitation and Betterment program, on page 239 of the December 1950 issue, a line of type was inadvertently omitted, with the consequence that Public Law 451 appears to delete from Public Law 335 language which does not appear in Public Law 335. We hereby reprint Public Law 451 with the previously omitted line in capital letters.

(PUBLIC LAW 451—81ST CONGRESS)

(CHAPTER 47—2d SESSION)

(H. R. 7220)

AN ACT

To expedite the rehabilitation of Federal reclamation projects in certain cases.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the second sentence of the Act entitled "An Act to provide for the return of rehabilitation and betterment costs of Federal reclamation projects", approved October 7, 1949, is amended by striking out the PERIOD AT THE END THEREOF AND INSERTING A SEMICOLON AND THE following: "except that, any such determination may become effective prior to the expiration of such sixty days in any case in which each such committee approves an earlier date and notifies the Secretary, in writing, of such approval: *Provided*, That when Congress is not in session the Secretary's determination, if accompanied by a finding by the Secretary that substantial hardship to the water users concerned or substantial further injury to the project works will result, shall become effective when the chairman and ranking minority member of each such committee shall file with the Secretary their written approval of said findings."

Approved March 3, 1950.

NOTES FOR CONTRACTORS

Contracts Awarded During December 1950

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
3168	Fort Peck, Mont.	Dec. 8	3 carrier-current relaying transmitter-receivers, one carrier line trap, 1,400 linear feet of coaxial cable, and 3 sets of line-protective and carrier-current relays for Fort Peck power plant and Glendive and Miles City substations.	General Electric Co., Denver, Colo.	$15, 504
DC-3208	Colorado - Big Thompson, Colo.	Dec. 11	Construction of Bald Mountain pressure tunnel and access roads, Estes Park-Foothills power aqueduct.	Winston Bros. Co., Monrovia, Calif.	1, 691, 262
DS-3209	Kendrick, Wyo.	Dec. 20	One 115,000-volt circuit breaker for Seminoe power plant additions, schedule 1.	Allis - Chalmers Manufacturing Co., Denver, Colo.	22, 891
DS-3213	Cachuma, Calif.	Dec. 29	One 38-inch diameter welded-plate steel pipe for outlet works at Cachuma Dam.	American Pipe & Steel Corp., Alhambra, Calif.	17, 100
DC-3219	Boulder Canyon, Ariz.-Calif.-Nev.	Dec. 18	Construction of earthwork, pipelines, and structures for laterals 88.6, 91.4, and 93.0, and sublaterals, part 1 of Unit 9, Coachella Valley distribution system, All-American Canal system.	R. V. Lloyd & Co., Coachella, Calif.	520, 734
DS-3223	Missouri River, Basin, Mont.	Dec. 8	Nine 9-foot 4-inch by 10-foot 8-inch bulkhead gates with bulkhead gate seats and guides, and bulkhead gate lifting beam for Canyon Ferry power plant.	Southwest Welding & Manufacturing Co., Alhambra, Calif.	24, 470
DS-3224	Fort Peck, Mont.	Dec. 1	One 20,000-kilovolt-ampere transformer with three 115,000-volt and three 34,500-volt lightning arresters for Shelby substation.	Pennsylvania Transformer Co., Canonsburg, Pa.	91, 405
DS-3232	Shoshone, Wyo.	Dec. 13	Glazed metal partitions, metal ceiling panels, and steel platforms for Shoshone power plant.	Macri & Hood Iron Works, Oakland, Calif.	13, 980
DC-3233	Riverton, Wyo.	Dec. 5	Construction of buried asphaltic membrane lining for Pilot canal.	Studer Construction Co., Billings, Mont.	79, 000
DS-3234	Eklutna, Alaska	Dec. 6	Materials for steel warehouse at Eklutna government camp	Soule' Steel Co., San Francisco, Calif.	29, 869
DC-3235	Columbia Basin, Wash.	Dec. 6	Construction of West canal main drains, drain W645.	Peter Kiewit Sons' Co., Seattle, Wash.	149, 866
DS-3342	Missouri River Basin, Mont.	Dec. 27	Three 12.78-foot by 21.78-foot fixed wheel gates for penstocks at Canyon Ferry Dam.	Treadwell Construction Co., Midland, Pa.	126, 900
DS-3247	Missouri River Basin, Mont.	Dec. 20	Miscellaneous structural steel, cast steel, and rails for Canyon Ferry power plant.	W. H. Reller Co., Boise, Idaho	14, 975
R1-CB-71	Columbia Basin, Wash.	Dec. 7	Constructing permanent residences, garages, streets and utilities at O&M Headquarters, Mesa, Wash.	Hunt & Willett, Inc., Brewster, Wash.	127, 086
117C-88	do	Dec. 13	Constructing fencing for left 115- and 230-kilovolt switchyards and left vista point at Coulee Dam.	McWaters & Bartlett, Boise, Idaho.	23, 260
200C-137	Central Valley, Calif.	Dec. 4	3-bedroom residences on Friant-Kern Canal, schedules 1 and 2.	L. B. Pipes, Fresno, Calif.	42, 967
R3-PX-54	Davis Dam, Ariz.-Nev.	Dec. 22	Construction of warehouse at system O&M area	Mardian Construction Co., Phoenix, Ariz.	59, 404
R3-B-18	Boulder Canyon, Ariz.-Calif.-Nev.	Dec. 15	Streets, sidewalks, curbs, gutters, and extension of sewerage and water distribution systems for Boulder City.	Boulder Construction Co., Las Vegas, Nev.	53, 254
R5-25	W. C. Austin, Okla.	Dec. 6	Construction of earthwork and structures for drain F and Altus Canal wasteway.	Poston Construction Co., Lawton, Okla.	44, 808
R6-48	Missouri River Basin, N. Dak.	do	Construction of Carrington, Edgeley, and Forman substations	Evans Electrical Construction Co., Omaha, Nebr.	135, 260
R6-49	do	do	Construction of Leeds, Bisbee, and Rolla substations.	do	110, 502
600C-50	do	do	Construction of Lakota and Valley City substations.	Electrical Builders, Associated, Mayville, N. Dak.	90, 746
600C-51	Missouri River Basin, Wyo.	Dec. 18	Clearing part of Boysen reservoir site schedule 4	Lindquist, Olsen & Co., Cambridge, Minn.	96, 800
704S-161	Colorado Big Thompson, Colo.	Dec. 6	Transformers, lightening arresters, horn gap switch, disconnecting fuses and relay cabinet for Lemon substation, schedule 1.	Westinghouse Electric Corp., Denver, Colo.	46, 030

Construction and Materials for Which Bids Will Be Requested by April 1951

Project	Description of work or material
Boise, Idaho	Construction of 2.3 miles of 4.16-kilovolt transmission line from Anderson Ranch Dam to Anderson Ranch government camp.
Boulder Canyon, Ariz.-Nev.	Construction of steel-frame warehouse, 9,600 feet in area, at Boulder City, Nev.
Buffalo Rapids, Mont.	Construction of surface drains in area A near Glendive, Mont.
Cachuma, Calif.	Construction of 75-foot high, 100,000-cubic-yard earthfill Glen Anne Dam on the west fork of Glen Anne Canyon, 4 miles northwest of Goleta, Calif.
Do	One 36-inch butterfly valve for Lauro Dam.
Do	Chlorination equipment for Tecolote tunnel chlorination and control house.
Do	Chlorination equipment for Lauro control station, South Coast conduit.
Central Valley, Calif.	Replacing two 2-mile wood-pole sections of Shasta-Tracy 230-kilovolt transmission line with steel tower sections by erecting steel towers, restringing conductor, and stringing new ground wires.
Do	Three 60,000-kilovolt-ampere transformers for Folsom power plant.
Central Valley, Calif.—(Continued)	Motor starters and float switches for Southern San Joaquin municipal utility district No. 3.
Do	9 pump manifolds for pumping plants, Southern San Joaquin municipal utility district.
Colorado-Big Thompson, Colo.	Construction of 400-cubic feet per second capacity Willow Creek pumping plant, 4 miles north of Granby, Colo., and construction of 2 miles of Willow Creek pump canal.
Do	Construction of 18 miles of 69-kilovolt transmission line between Gore substation and Muddy Pass substation north of Kremmling, Colo.
Do	Two 8-foot by 7.5-foot top seal radial gates and 5,000-pound radial-gate hoists for Willow Creek Dam.
Do	2,500-ampere generator voltage bus structure for Pole Hill power plant.
Do	One 13,000-horsepower generator-motor unit for Flatiron pumping plant.
Do	Two 5,000-horsepower synchronous motors for Willow Creek pumping plant.

Construction and Materials for Which Bids Will Be Requested by April 1951—(Continued)

Project	Description of work or material
Colorado-Big Thompson, Colo.—(Continued)	Main control board, annunciator relay cabinet, recording board, 460-volt unit substation, two 460-volt power distribution boards, two 460-volt heating control centers, three 460-volt motor control centers, one 240/120-volt lighting distribution cabinet, one 125-volt distribution and control board, and one 75-kilovolt-ampere lighting transformer for Flatiron power plant.
Do	Main control board, supervisory and distribution boards, two 125-volt battery chargers, two 500-kilovolt-ampere transformers, and one 37.5-kilovolt-ampere lighting transformer for Pole Hill power plant.
Do	Main control board for Beaver Creek substation.
Columbia Basin, Wash	Construction of a 17-mile unlined reach of East Low canal and 0.5 mile of unlined Lind Coulee wasteway, 10 miles from Moses Lake, Wash.
Do	Construction of 50- by 100-foot machine shop, 30- by 55-foot storehouse, 10-car garage, and two 10-truck garages at Quincy, Wash.; a 60- by 100-foot warehouse, 10-car garage, and two 10-truck garages at Othello, Wash.
Do	Construction of 150- by 70-foot machine shop at Othello, Wash.
Do	Construction of a municipal building for the city government of Coulee Dam, Wash.
Do	Construction of a building for housing radio receiving and transmitting equipment at Ephrata, Wash., and radio equipment buildings at Quincy and Othello, Wash.
Do	Construction of 54 miles of safety fence, cattle guards, and gate between Soap Lake and Quincy, Wash., and near Moses Lake, Wash.
Do	Installing a 16,000-pound radial gate and hoist in a check structure at station 1992+70, West canal, 5 miles southwest of Quincy, Wash.
Do	Drilling about 40 drainage observation wells near Moses Lake and Quincy, Wash.
Do	Grading and surfacing about 5,000 square yards of driveways and parking areas at Ephrata field office site.
Davis Dam, Ariz.-Nev	Erecting steel structures and installing electrical equipment for Cochise substation, southwest of Willcox, Ariz.
Do	Construction of concrete spillway stilling basin at Davis Dam.
Deschutes, Oreg	Drilling test holes at Haystack Dam near Madras, Oreg.
Fort Peck, Mont	Construction of pole top extensions and stringing 35 miles of two 3/8-inch galvanized steel overhead ground wires on the Fort Peck to Wolf Point section of Fort Peck-Glendive 115-kilovolt transmission line.
Hungry Horse, Mont	High potential test set for Hungry Horse power plant.
Kendrick, Wyo	Construction of 3,750-kilovolt-ampere Rawlins substation.
Do	Construction of 30 miles of Sinclair-Hanna 34.5-kilovolt transmission line.
Do	Construction of laterals and concrete structures on Johnson sublateral extension, 13 miles northwest of Casper, Wyo.
Do	Two 160-inch turbine butterfly valves for Alcova power plant.
Missouri River Basin, Colo.	Construction of 3,000-kilovolt-ampere Julesburg substation.
Missouri River Basin, Mont.	One 9.04- by 9.04-foot fixed wheel gate lifting frame, 1 gate engagement indicator, and 4 gate slot closures for Canyon Ferry Dam.
Missouri River Basin, Nebr.	Spillway stop log guides for Trenton Dam.
Missouri River Basin, N. Dak.	Construction of 750-kilovolt-ampere Fort Clark substation, near Stanton, N. Dak.
Do	Construction of 4 miles of Garrison (Fort Peck tie) 115-kilovolt transmission line connecting Williston-Garrison and Garrison-Bismarck lines at Garrison Dam, N. Dak.
Do	Construction of Fort Clark pumping plants, canals, laterals, and surface drains near Stanton, N. Dak.
Do	Construction of short distribution lines and small substations to serve Fort Clark pumping plants.
Do	Relocation of 2 miles of county road and raising county bridge near Dickinson Dam site.
Do	Construction of a permanent camp at Heart Butte Dam near Glen Ullin, N. Dak.
Do	Supervisory control and selective telemetering equipment for 12 substations controlled from Jamestown substation.
Missouri River Basin, S. Dak.	Construction of 3,750-kilovolt-ampere Gregory substation.
Do	Construction of a camp at Shadehill Dam site.
Do	Main control boards, distribution boards, and battery charging and control equipment for Sioux Falls, Huron, and Watertown substations.
Missouri River Basin, Wyo.	Construction of 15,000-kilovolt-ampere Boysen switchyard.
Do	Installation of equipment for 15,000-kilovolt-ampere Boysen switchyard.
Do	Grouting contraction joints at Kortes Dam, 62 miles southwest of Casper, Wyo.
Do	Construction of 24 miles of 34.5-kilovolt transmission line between Pine Bluffs, Wyo., and Kimball, Nebr.
Rio Grande, N. Mex	Construction of 7,500-kilovolt-ampere Willard substation.
Do	2 control boards, 2 battery chargers, and 2 distribution cabinets for Belen and Willard substations.
Shoshone, Wyo	Placing asphalt lining on various reaches of Heart Mountain canals and laterals, totalling about 25 miles, 10 miles north of Cody, Wyo.

United States Department of the Interior
Oscar L. Chapman, Secretary
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Washington Office: United States Department of the Interior, Bureau of Reclamation, Washington 25, D. C.

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Ruth F. Sadler, *Editor*

Subscription rate $1 a year for persons residing in the United States and Canada; $1.50 a year for foreign subscriptions; special rate of 50 cents a year for members of water users' associations, and Bureau of Reclamation employees.

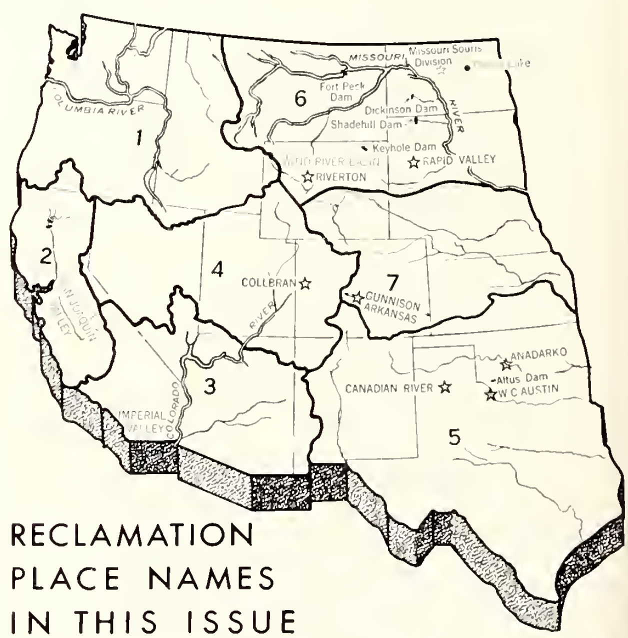
OUR FRONT COVER

PLOWING, PLANTING, PRAYING, plus hard work made the miracle of Ralston Bench (see page 226, December 1950 issue of the *ERA*). Ralston Bench settler A. G. Kamm is a typical example of the hard-working farmers of the Shoshone project who drew farm units in September 1949, and put them in crops within a year. Photo by Charles Knell, Region 6 photographer.

30 YEARS AGO IN THE ERA

The season is here when tree planting on most of the projects might occupy to advantage some of the attention of our farmers, their boys and girls. Last year we were pleased to note that a number of our farmers had given thought to this subject and had set out trees of several varieties along the roadsides, ditch banks, and about the homes. This movement set in some years ago on the Orland project, where concerted efforts were made to encourage tree planting. The results have been most gratifying.

(From Current Comments, Gathered from the Project Press and People, by C. J. Blanchard, Statistician, page 103 of the March 1921 issue of the RECLAMATION RECORD, predecessor to the RECLAMATION ERA.)



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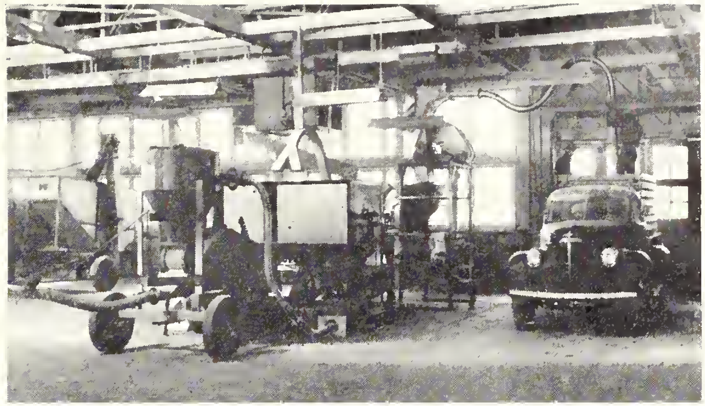


CASTOR BEANS for Peace or War

HARVESTING castor beans after frost on W. C. Austin project in top photo. COMBINE is fitted with castor bean attachment to handle "dwarfs" immediately above. HULLING PLANT—Beans unloaded by suction pipe and weighed in bin scales. *Lower inset submitted by the author, other photos by P. W. George, Region 5.*

by W. E. DOMINGO, Director of Agronomy, The Baker Castor Oil Co., New York

Castor beans have two-way possibilities. During peace time the crop provides needed diversification and cash income. If war is ahead, the crop takes on special military importance and its culture will benefit not only the grower but the defense effort.

Over the past 50 years, chemists have found scores of industrial uses for castor oil and its derivatives. They have put castor oil products in everyday items like paint, plastics, varnish, nylon, cosmetics, rayon, hydraulic fluids, textiles, lubricants, asphalt tile, and electrical systems. One major castor oil producer sells 185 products made from castor beans, with about 100 other products in the development stage.

Today, the defense agencies are urgently demanding products from castor beans for use in military equipment, materials, and supplies.

The demand has long exceeded the world supplies of castor beans, and because of the present international situation, no foreign source of any item can be assured. Therefore, there is a definite need for culture of castor beans as a farm crop in the United States. Estimates on the land area necessary to satisfy anticipated needs for castor bean products range from 100,000 to 1,500,000 acres depending on areas of production (yields per acre) and costs of production per pound of beans.

Castor beans in the United States are domesticated wild rogues of the tropics. In its native state the castor bean is a robust perennial that dehisces (bursts open and ejects) its seeds violently. Since most types introduced into this country bloom little the first year and since the plant is sensitive to frost, breeders concentrated first on producing a plant that would bloom early. Whereas many castor plants grow to 12-foot heights and produce as many as 40 nodes during a growing season without blooming, several strains now available flower at the sixth node, which is only some 10 inches from the ground. Further, breeders have developed short slender plants with spikes which resist shatter and dehiscence. These new "dwarf" varieties, which are adapted to specific areas within the United States, are now available in quantity and are being used on commercial acreages in those areas exclusively.

Castor-bean plants grow, develop seed heads, and mature most rapidly in a dry, hot atmosphere. In such a climate, fungal diseases are kept to a minimum, and the mechanical harvesting and

hulling processes are most easily performed. However, the crop cannot be classed as drought-resistant—a short period of stress for moisture can be very damaging to castor-bean development and yield. The plant's indeterminate habit of growth means that the longer the season the greater the yield. The irrigated valleys of the Southwest are choice locations for castor beans—and both experimental data and field experience bear that out. Farmers are testing the agricultural and commercial possibilities of raising castor beans under irrigation in the Imperial Valley and San Joaquin Valley of California and on the W. C. Austin project in southwestern Oklahoma. As the techniques of culture and the pattern of marketing become fixed, the crop will no doubt expand into similar areas of the South and West. The national emergency may accelerate production, possibly during the 1951 season.

Castor beans are raised much like cotton. The crop needs a well-drained soil and, under most conditions, only a little fertilizer. It is grown in rows with cotton equipment, except for special planter boxes. Because of the large seed and long germination period, castor beans are preferably "irrigated up." The crop uses upward of the same amount of water as cotton, depending on area and the period of year of culture. Like cotton, the castor-bean plant must be stripped of leaves (defoliated) before harvesting. For post-frost harvesting the crop is conveniently defoliated by the first subfreezing temperature. For prefrost harvesting, defoliation is accomplished on some soils by withholding irrigation water and on others by chemical solutions applied by airplane. The latter is usually very profitable in that it permits a longer period of active seed-set.

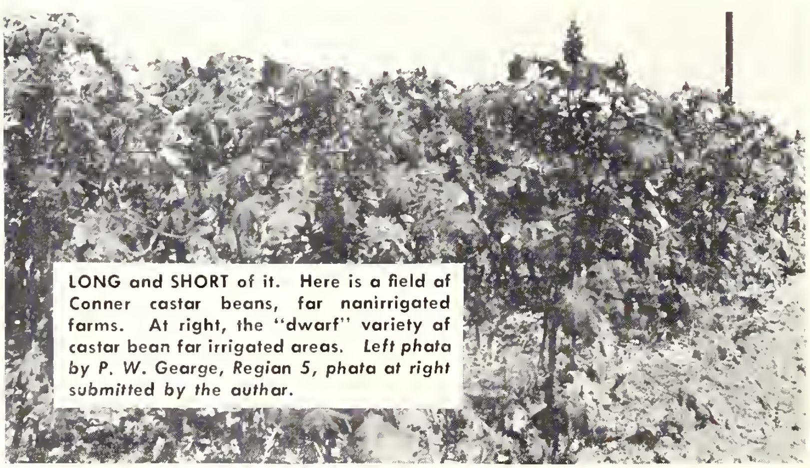
As the plant and stem sizes were reduced, combine harvesting came within the range of practicability. The serious problem—the loss of shattered capsules in getting the plant cut and into the machine—was solved through the joint efforts of many people and agencies, including designers and manufacturers of harvesting equipment, and growers. Today the Massey-Harris Co. has available a castor bean combine harvester with an efficiency well within the range of that now accepted on other crops. That combine is basically a grain or peanut machine with a special castor bean attachment on the front end. It removes the three-segmented capsules from the plant. A separate hulling operation, at present, is needed to remove and separate the hull from the bean.

Hulling equipment has been greatly improved in the past few years. Now available on the market is a portable huller which operates at field-edge serving two combines simultaneously with the harvesting. Clean beans are loaded in trucks for bulk movement to points for consolidation and shipment in carload lots to extraction plants.

All costs of production including harvesting, hulling, and movement to consolidation points, but exclusive of land rental, are estimated to be some \$50 to \$60 per acre.

The dwarf varieties can be grown for the full season in the areas mentioned without growing excessively tall. With good cultural methods, yields for that period will be from 2,500 to 3,000 pounds per acre. These varieties also are being "double-cropped" in those valleys with long growing seasons by following spring-harvested vegetables, grain, flax, or potatoes. The shorter grow-

(Please turn to page 50)



LONG and SHORT of it. Here is a field of Conner castor beans, for nonirrigated farms. At right, the "dwarf" variety of castor bean for irrigated areas. *Left photo by P. W. George, Region 5, photo at right submitted by the author.*

THE CASTOR BEAN OUTLOOK

by D. M. CROOKS, Head Horticulturist, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, United States Department of Agriculture, Beltsville, Md.

Only recently has the castor bean plant taken on aspects of a promising agricultural crop. Heretofore in the United States it has been more of a dooryard ornamental weed or a subject for experimental testing and development. Unlike many of our established crops, its products were in great demand for a multitude of industrial uses in advance of the development of any varieties suitable for crops as measured by American standards of agriculture.

An adequate supply of castor oil or its products from foreign sources before and after World War I, with the consequent development of many new and important industrial uses, led to a serious domestic situation when supplies were limited during the two world wars. Since World War II, the supply situation is increasingly more difficult because of ever-increasing uses of the castor-oil products. During the past decade the possibilities for domestic production have changed entirely with the development of acceptable varieties through scientific breeding and selection for yield, local adaptation, and mechanical handling. The new varieties fulfill the general requirements of any good crop plant for uniformity of plant type and seed, acceptable yields, fair freedom from disease, economical crop handling by machinery, and mechanical hulling. All of these factors must now be developed concurrently for a successful crop. The variety development is basic to all other advances for the castor-bean plant to take its place as a major United States crop. Only with the development of the several new varieties did castor beans become a potential crop for the irrigated regions. While the varieties now at hand are acceptable for crops in the specific regions where they were developed, and far ahead of anything known prior to World War II, they are only a beginning for what may be expected with continued efforts in the same directions within the next 10 years.

Farmers in many areas need new crops, and the important industrial uses of castor beans are sufficient to require the production of from 300,000 to 400,000 acres annually. The varieties recently developed are acceptable, and better ones for improved yields, easier handling, and new areas, are within sight. The potential for a sizeable castor-bean crop is high and within reach. •

TODAY'S castor bean centers are depicted by arrows on map based on information supplied by the Baker Castor Oil Co. of New York. National defense needs may prompt a vast extension of these areas. ***Map by Graphics Section.***

The Canadian River Project

by GARFORD L. WILKINSON, Regional Information Officer, Region 5, Amarillo, Texas

ELEVEN TEXAS TOWNS will benefit from the Canadian River project. Two typical towns are shown at upper left, Pampa (top) and Lubbock. *Photos courtesy of the respective Chambers of Commerce.*

A DREAM, CONCEIVED IN THE MINDS OF EARLY-DAY COMMUNITY BUILDERS and nourished by present-day residents concerned about ample water supplies for rapidly expanding metropolitan centers in the Panhandle-Plains area of Texas, moved a step nearer realization on December 29, 1950, when President Truman signed a bill authorizing the 85-million dollar Canadian River project.

Actual construction of the project cannot begin until consent of the Congress has been granted to a compact providing for the division of the waters of the basin among the States of New Mexico, Texas, and Oklahoma, and until funds are specifically appropriated by the Congress.

The project is designed by the Bureau of Reclamation to provide municipal water supplies for 11 Texas cities—Amarillo, Borger, Pampa, Plainview, Lubbock, Tahoka, O'Donnell, Lamesa, Slaton, Levelland, and Littlefield. These cities now obtain water from drilled wells, and Geological Survey records show that current withdrawals in the area are more than 20 times greater than ground-water replenishments.

Possibilities of a dam and storage reservoir on the Canadian River in Texas, approximately 237 river miles downstream from Conchas Dam, which stores water for the Tucumcari, N. Mex., irrigation project, were first noted by the late Sid Stinnett of Amarillo. Mr. Stinnett was instrumental in the creation of new communities on the Texas plains, helping to bring railroads into the area; helping to build modern highways, schools, colleges, and many other necessities and conveniences in a new and progressively expanding region. Fate called for Mr. Stinnett's plans for a dam on the Canadian in Texas to pass to other, younger builders of the West.

By 1948, officials of cities throughout the project area had become increasingly alarmed about the declining ground-water tables, and the increasing population in a rich oil, helium, gas, wheat, and cattle-raising region. Civic leaders, then as now, believed that the cost of constructing a dam on the Canadian River could be justified if other advantages resulting from the dam and reservoir were considered along with flood control. From this came a plan for a multiple-purpose project providing for municipal and industrial water supplies, fish and wildlife propagation, recreation, irrigation, and flood control.

Project studies were initiated by the Bureau under direction of Regional Director H. E. Robbins on March 1, 1949, and a preliminary report on these investigations was presented to the public on June 17, 1949.

Hardly had the report been received by businessmen in the area until they were talking on long-distance telephones with their representatives in Washington, D. C. Key spokesmen for the area were checking airline schedules linking the Panhandle with the Nation's Capital.

Success rewarded their efforts, and with the help of former Representative Worley, Congressmen Mahon and Rayburn, Senators Johnson and Connally, and other Texas representatives, the Canadian River project was authorized in the closing days of the Eighty-first Congress.

The Canadian River project dam is designed as an earth-fill structure, 7,200 feet long with a top width of 40 feet. Maximum height will be 186 feet. Cost of the project, including the dam and reservoir, a water-transportation system to serve project cities, irrigation and recreational features, moving Amarillo's sewage plant, and all rights-of-way, is estimated at $85,383,000.

INDUSTRY—Borger, Tex., above, will benefit from CANADIAN RIVER development, damsite shown above right. For example, OIL REFINERY near Amarillo, Tex., at right.

The project's reservoir will extend 20 miles upstream from the dam. It will have a capacity of 1,956,000 acre-feet of uncontrolled super storage. The reservoir will cover 26,300 acres. The dam site is at Sanford, near the city of Borger, Tex., about 50 miles northeast of Amarillo.

The authorization act provides for repayment by the cities of the municipal and industrial water supply features of the project. The estimated cost tentatively allocated to these features is $77,892,000. This cost, plus interest to be designated by the Secretary of the Treasury, is to be repaid over a period of not more than 50 years.

None of the 11 cities will be required to advance funds for construction. A central organization will contract with the Federal Government to purchase water from the project's system for a specified period of years and the payments will be made on an annual basis, similar to plans used by many public utilities.

"The Canadian River project," said Secretary of the Interior Oscar L. Chapman recently, "will be an important example of basic conservation. Water now flows down the river valley to the sea, while at the same time whole communities are undermining their future prosperity by the exhaustion of their ground-water supplies. This project is not only an economical means of providing the additional water the project cities will need for their future growth; it is also a means of preserving our heritage of fundamental resources."

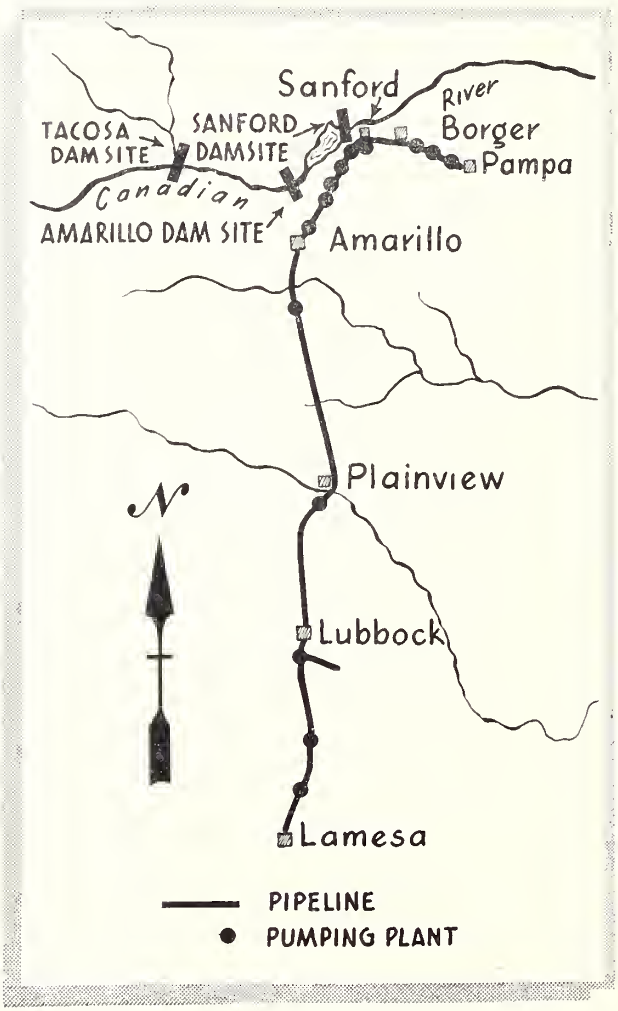
Commissioner Michael W. Straus noted that project investigations indicated clearly the need for the water-supply project. Population of the project cities in 1950 was approximately 265,000. Commissioner Straus observed that the anticipated population of the 11 cities will increase

greatly by the year 2000, when the new system will have been practically paid for by the water users.

Among the many persons who have contributed greatly to the success of the project up to the present time are Amarillo's Mayor Gene Klein, its Chamber of Commerce Manager Rex Baxter, John L. McCarty, president of the Panhandle Water Conservation Association, Lawrence Hagy, Jay Taylor and J. E. Cunningham; Borger's Mayor George Finger, its City Manager A. A. Meredith, and Borger citizens Joe Cooley, Fritz Thompson, Hudson Davis, and Welson Jolly; Mayor Sam Richardson of Lamesa; Clarence Whiteside, chairman of the Canadian River Project Organization and State Representative Preston Smith, E. K. Hufstedler, and Irvin Jones, all of Lubbock; Art Chesher of Littlefield; O'Donnell's Mayor R. O. Stark; Pampa's Mayor C. A. Huff, its City Manager Dick Pepin, Chamber of Commerce Manager E. O. Wedgeworth, and Pampa citizen Fred Thompson, and Plainview's Col. Winfield Holbrook.

Newspapermen in the area also have performed yeomen service in keeping the people informed about the need for and work being accomplished on the Canadian River project. THE END.

CANADIAN RIVER PROJECT—represents a Texas water boon. Drawn by Graphics Section, Wash., based on Region 5 map.



Castor Beans for Peace or War

(Continued from page 46)

ing period under this plan reduces yield to some 1,500 pounds, but the land rental borne by the beans is, of course, reduced.

During the last quarter of 1950 the price of castor beans delivered to scattered receiving points of one major company has been in the range of 9 to 10.9 cents per pound, depending on location.

These concurrent developments in the fields of variety improvement, adaptation, cultural methods, mechanical harvesting, mechanical hulling, and marketing have laid a sound foundation on which domestic castor-bean production can be built as either a normal peacetime development or a wartime emergency. THE END.

Dexheimer's Mission Aids Private Business

At the request of the Australian Government, W. A. Dexheimer, assistant construction engineer of the Bureau's Denver Federal Center, served as a technical adviser to that Government on two large Australian water projects—Snowy Mountain power and irrigation project, and the Kiewa tunnel.

In presenting his report, Mr. Dexheimer suggested that Australia should take advantage of world experience by letting contracts to overseas firms capable of carrying out the design and construction for various phases of the work. Upon issuing a statement to the press, Australia's Minister for National Development, Mr. Casey, supported this view, saying, "It would not be possible for Australia to try and carry out all the works required for our rapidly expanding economy from the resources available within this country." ●

SURVEYING—Bureau of Land Management crew at Logan Gulch on Muskrat Creek, tributary of Wind River (above). *BLM photo.* SILT CARRIER Five Mile Creek as it meets the Big Horn River (right). *Photo by Charles A. Knell, Region 6.*

All Eyes on WIND RIVER

Part Two

WORKING ON WIND RIVER

by C. C. BUTLER, Land Use Specialist, Branch of Operation and Maintenance, Region 6, Billings, Mont.

"More detailed information is now available on the resources of the Wind River Basin than any other watershed in the United States. These data will form the basis for a conservation program that will show the world what can be done with an entire watershed in using land and water resources in such a way that the greatest benefit will be provided the greatest number of people." These were the words of W. G. Sloan, then chairman of the Interior Missouri Basin Field Committee as he summarized the accomplishments of the various Interior Department agencies at the special Field Committee meeting held at Riverton, Wyo., November 7–9, 1950.

Since April 1948, technicians of the Bureau of Reclamation, Bureau of Indian Affairs, Bureau of Land Management, Geological Survey, Fish and Wildlife Service, Bureau of Mines, and the Weather Bureau have been combing the watershed from the highest peaks of the Wind River Range to the Wind River Canyon to obtain basic information for the most complete conservation program ever planned for a basin.

The Bureau of Land Management and the Bureau of Indian Affairs have completed the land classification and land resources inventory, covering approximately 3,650,000 acres, or 70 percent of the watershed area, excluding only the irrigable lands of the basin.

The Geological Survey and the Bureau of Reclamation joined in completing hydrologic studies of the basin to determine how much water each significant watershed might discharge normally or at a maximum. These studies showed that annual runoff from the Wind River Mountains is generally large in amount, comparatively stable and forms a dependable flow for irrigation and other water development. The Bureau of Reclamation developed a report entitled "Peak Discharge Study of the Wind River Basin," for use in flood control work. The Weather Bureau of the Department of Commerce, cooperating with the Bureau of Reclamation, furthered this study by installing and operating a cooperative network of meteorological stations, which almost quadruples the former density of coverage on the watershed prior to 1948.

When the Wind River investigations were initiated, no one knew where the large quantities of silt which were being carried out of the basin were coming from. The Geological Survey drew the assignment of answering this question. The gaging station at Thermopolis was supplemented by stations on all the tributary streams of the Wind River, concentrating on Five Mile and

Muddy Creeks, known to be heavy contributors of silt. Although preliminary, analysis of these data show that about 4 percent of the total water runoff came from above the Riverton project, about 88 percent came as direct runoff from the irrigation project, and the remaining 8 percent from small unmeasured drains and subsurface percolation into the channel. Further analysis indicates that approximately 86 percent of the silt loss was derived from the stream channel throughout the 28-mile stretch through the Riverton project, about 10 percent from the irrigated lands and the remaining 4 percent from the watershed lands above the irrigation project. The 1950 records generally confirmed those of 1949.

During 1949 Muddy Creek had only natural flow, as no waste water from irrigation was emptied into the creek. During 1950 new settlers irrigated a few hundred acres in the North Portal area of the Riverton project and dumped waste water into the creek channel. As a result, runoff and silt load increased ten fold over the 1949 record. The increase was due in a large part to operational waste.

Analysis of the silt load in the main stream below the lowest tributary shows that 45 percent of the silt originated in Five Mile Creek, 18 percent in the Wind River and Popo Agie River, 13 percent in Muddy Creek, 5 percent in Bad Water Creek, and the remaining 19 percent from other tributaries.

With this information on where the silt was coming from, the three agencies that manage public lands in the basin explored using various types of dams and reservoirs to keep it under control.

Technicians of the Bureau of Indian Affairs covered each subwatershed on the Indian reservation and located 240 sites for retention and detention dams, and 100 diversion dam sites for water spreading. Under the soil and moisture conservation program 127 small dams of various types have already been constructed.

The Bureau of Land Management surveyed areas of the public domain for the same purpose and during the preliminary survey located possible sites for 47 large silt detention reservoirs, 460 small retention dam sites, and 135 reservoirs strictly for stock watering. On Logan Gulch of Muskrat Creek the sites are being resurveyed to determine if proposed reservoirs would provide the necessary storage for a 50-year-frequency storm.

The Bureau of Indian Affairs is also conducting the same type of investigations on Five Mile and Muddy Creeks above the Riverton project.

The Bureau of Reclamation has located and surveyed three such sites for the larger reservoirs, one on Five Mile Creek, and two on Muddy Creek above the irrigated lands. These sites would provide a combined flood storage of 103,500 acre-feet and cover 2,400 acres.

The field committee also asked each of the three action agencies to find out whether various kinds of vegetative plantings would be effective in stream bank stabilization and erosion control. In the upper watersheds of the public domain the Bureau of Land Management selected 7 sites for stabilization of small stream banks covering approximately 48 miles of stream channel. During 1949 and 1950, 48,600 willow cuttings, 16,200 Russian Olive seedlings, and 300 cottonwood trees were planted. In addition 400 lineal feet of live

(Please turn to page 60)

SOIL AND WATER SAVING willow spiders are planted under Bureau of Indian Affairs supervision (left). Note how they take root and sprout, growing stronger every year. Golden willows are planted near Five Mile Creek by Reclamation crew. *Left photo courtesy of the Bureau of Indian Affairs. Right by T. R. Broderick, Region 6, Bureau of Reclamation photographer.*

PEACE AND PLENTY—The goals of the participants in the Fourth Inter-American Conference on Agriculture are typified in this poster set up in Montevideo, Uruguay, in honor of the event. The effectiveness of this huge and vivid symbol, with the flags of the participating nations below it, is somewhat diminished in the black and white photo at right. ***All pictures illustrating this article were made from Kodachrome slides taken by the author.***

Latin-American Resources

by WESLEY R. NELSON, Assistant Commissioner of Reclamation

Latin America, a land of great contrasts, with glaciers and jungles, Alp-like mountain peaks and desert oases, swamps, and smoking volcanoes, is also a continent with great potentialities for water-resource development. Immediate possibilities for development are also variable, depending upon the physical, social, economic, and political climate of each area.

When I was appointed as a member of the United States delegation to attend the Fourth Inter-American Conference on Agriculture at Montevideo, Uruguay, last year, I was able to serve in a dual capacity, as a technical advisor to the conference, and a consultant on the possibilities of the United States providing technical assistance to our Latin-American neighbors under the President's Point Four Program.

The globe on page 54 delineates the route taken to cover these assignments, with indications of points of interest which were viewed during the tour.

At San Salvador was a scene typical of Central America—a beautiful, modern, metal and marble airport building, with glittering airplanes, symbol of modern transportation, and a few steps beyond, primitive oxcarts hauling sugarcane.

At Managua, Nicaragua, the possibilities of developing the water resources of that country were discussed with the government officials. Nicaragua has rivers running all over the place, one of the greatest being the Rio Grande which flows from the west to the east, and empties into the Caribbean Sea. There is very little irrigation, and this is accomplished by simple diversions. Nicaragua is the largest of the Central American States, and its two lakes, Managua (30 miles long by 15 miles wide), and Nicaragua (100 miles long and 45 miles wide) are two of its most prominent features.

Hot springs might be developed as a source of electric energy, similar to installations in Italy, and there are tremendous possibilities for hydroelectric development—as much as 700,000 kilowatts. One potential power drop could be developed from Lake Managua, which now drains into Lake Nicaragua, by damming the River Tipitapa, diverting into Lake Managua the streams which now flow into the Caribbean, or into Lake Nicaragua, and dropping these waters into the Pacific Ocean.

The people in Nicaragua agree on the need for water-resource development and are waiting for a plan which would be possible for them to carry out.

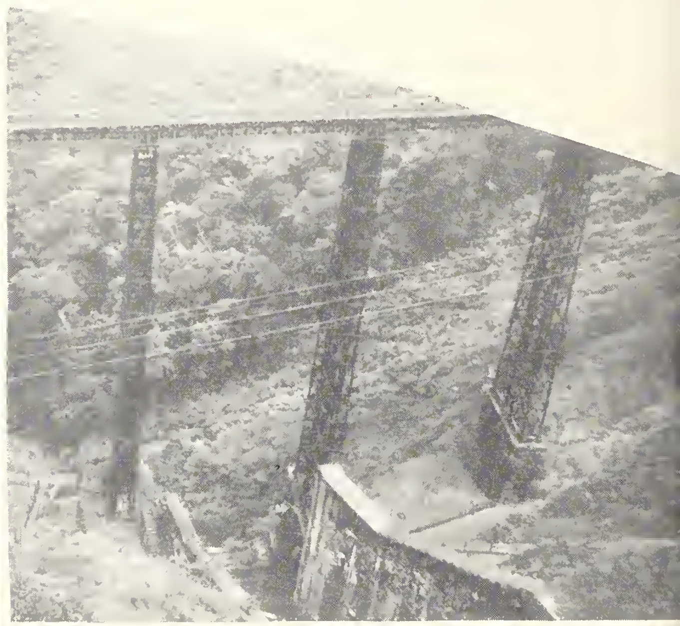
In Peru, the land of the Incas, the people have been irrigating for hundreds of years, and more than a million acres of land are under irrigation. In general the remaining irrigation development would be most costly, involving transmountain diversions. Peru is also multiple-purpose minded, and is now developing a project on the Santa River similar to our TVA.

Short rivers run to the sea from the high Andes

and many of these have tremendous hydroelectric potentialities which could be easy to develop. The glaciers and glacier lakes of Peru present many problems of engineering which we recommended be referred to technicians familiar with engineering in Switzerland where similar problems have been encountered. One specific problem on which the Peruvians asked for assistance was that of lining high-pressure tunnels.

Perhaps something should be said about Peruvian weather. The climate at Lima is like that of San Francisco except that it has not rained in about 25 years. Cool, and overcast most of the time, the streets are often wet, but from condensation, not from rain. About every 20 years, an unusual juxtaposition of the cool Humbolt Current from the south and warm December winds from the north bring terrific storms to the coast of Peru. Before these onslaughts of nature, man and his works are unprepared, and the damage is great.

Bolivia, the "Switzerland of South America" has two capitals, any kind of climate from equatorial heat to Arctic cold, great mineral wealth, tremendous water resource potentials and wonderful opportunities for development, retarded only through lack of opportunities for the natives, lack of purchasing power, transportation, and trade



THE LAND OF GREAT CONTRASTS as photographed by Assistant Commissioner of Reclamation Nelson during November and December 1950. The map at lower left delineates his trip by plane and ship. Above the map, the Andes, with fertile valley lands. Immediately above, the cableway near Sao Paulo, west of Santos, built by British engineers, showing the trestle over which the train runs, and evidence of the "best job of surface drainage" Mr. Nelson reports having seen. At upper right, symbols of modern and primitive transportation at San Salvador. At extreme upper right, another view of the Sao Paulo cableway, indicating the great heights to which it climbs.

outlets. Although the legal capital is at Sucre, La Paz (meaning "peace") is more accessible and is the actual seat of government. La Paz lies in the heart of a gigantic canyon about 3 miles wide, 10 miles long, and 1,500 feet deep. Despite the depth of the canyon, La Paz is at an elevation of about 12,700 feet—and it is not on the level. A

walk is an arduous undertaking for those unaccustomed to the high altitude.

Near Cochabamba is the Angostura Dam, whose name indicates how closely related we are to South America. The word means "narrows" and the dam was built and named by a Mexican engineer, as it was similar to the Angostura Dam he had built in Sonora, Mexico. Homer Derr, the South Dakota State engineer, worked on the South American dam and when seeking a dam site in his home State was so reminded of the Bolivian "narrows" that he named it Angostura (see the December 1949 issue of the Reclamation Era for "Angostura Shows the Way").

Bolivians are having a great deal of trouble with their Angostura Dam. It is now storing silt at a rapid rate, and some of the irrigated land is going out of production because of alkali and seepage.

In Bolivia and Peru is famed Lake Titicaca, the largest lake in South America (4,000 square miles), and the highest lake in the world used for navigation by steamboats. It is 12,500 feet above sea level.

Although Bolivia's greatest wealth at the present time is in its minerals, it is a potentially rich agricultural country, and the majority of the natives raise crops for a livelihood under most primitive conditions. Because of Bolivia's particular problems we recommended sending one drainage engineer to that country to tackle the immediate problem of rehabilitating the Angostura project, and an irrigation engineer to explore the development of simple diversion projects which could be built by the water users with the technical assistance and guidance of the government. Bolivia needs technical assistance and development, but due to many social and economic factors would not be fully able to utilize extensive irrigation and hydroelectric power projects at the present time.

Chile was in direct contrast to Bolivia. Here Point Four could be put into reverse, as engineers from many countries could learn a great deal from the excellent technicians in Chile. Around Santiago is the Central Valley, a large green irrigated area containing many orchards. A development corporation is now building for the State a comprehensive water-development program, including hydroelectric plants and transmission systems to

make low-cost power available to the whole country. Recently Chile has considered developing irrigation from underground water in the strip of desert along the coastline. As I flew above this area, I could see the tiny rivulets as they trickled down the Andes, across the white sands of the desert, and vanished from sight, never to reach the sea. Dotting the desert are many small oases, where simple diversion irrigates many crops including citrus.

From Santiago to Buenos Aires, the plane does not fly above the 22,000-foot peaks, but dodges in and around them, including Aconcagua, between Argentina and Chile, the highest mountain peak in the Western Hemisphere. A beautiful airport is being built 35 miles from Buenos Aires, and a four- to six-lane highway provides an impressive approach to that city. Argentina does not want to be considered undeveloped, and officials seem to feel that the country would prefer to be on the sponsoring, rather than the receiving, side of the Point Four Program.

Uruguay offered a contrast to many Latin countries, for here was evidence of a strong middle class. Uruguay is about the size of North Dakota, and in natural resources is like a cross section of western United States. Citrus groves appear close to the coast and as the elevation rises, there are truck farms, wheat and corn. Farther north is the plains country similar to the high plains of Texas, with one notable exception—rheas graze along with cattle and sheep. A multiple-arch dam and 120,000 kilowatt power plant, located on the Rio Negro, near the geographic center of the state, is busily producing energy for Montevideo and the adjoining countryside.

A large delegation of experts from the United States attended the Inter-American Conference on Agriculture, and the regional conference of the Food and Agriculture Organization of the United Nations at Montevideo. There was complete harmony in the discussions of the commission of which I was a member and the resolutions emphasized the need for the different countries to develop basic data necessary for determining the appropriate methods and kinds of water resources development. Numerous recommendations on specific problems of agriculture were developed by the conference.

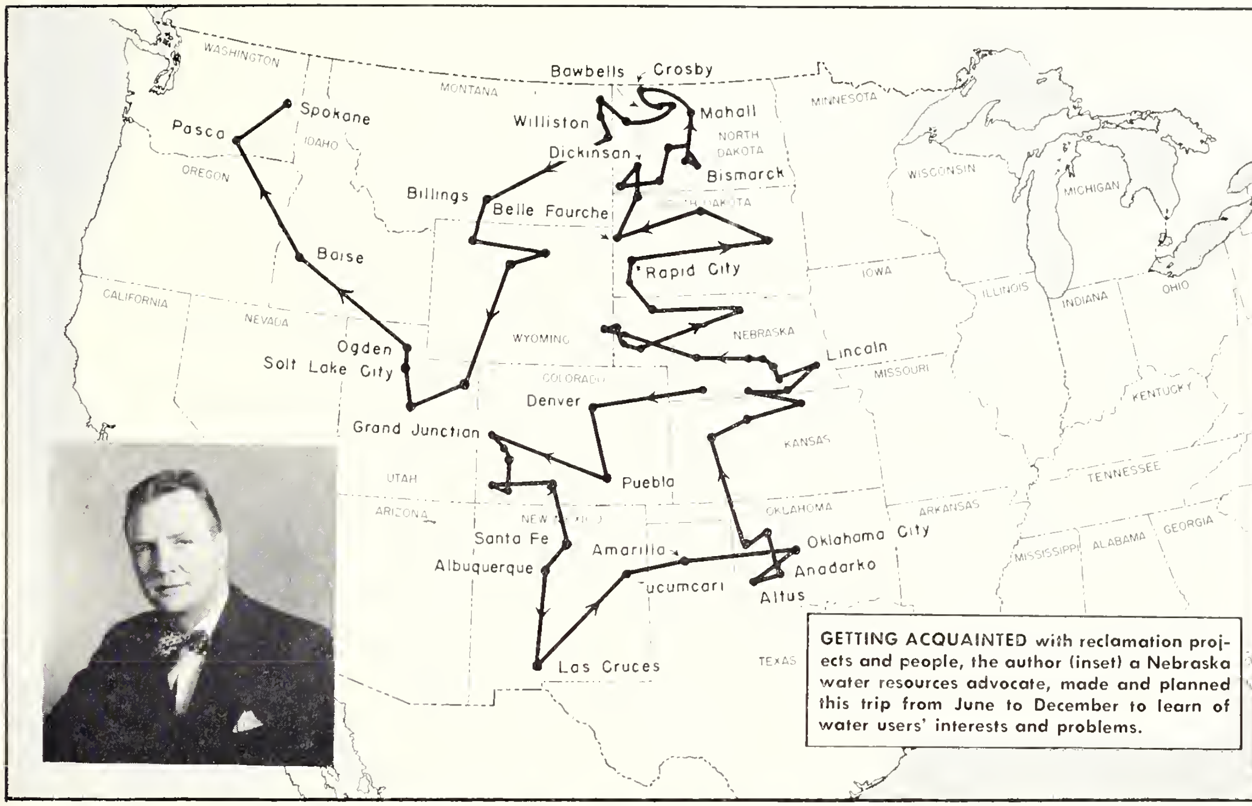
I left the country, feeling that there were tremendous natural resources available in most of these Central and South American countries, and that the doors of this storehouse of untold wealth could be readily unlocked through the knowledge and skills of today's technicians. THE END.

Vasey Surveys Colombia's Budget

Tom K. Vasey, regional programs and finance officer at Sacramento, Calif., went to Bogota, Colombia, early in November 1950 for a 5- to 6-month assignment as part of the Public Administration Survey being directed by Lauchlin Currie. Mr. Vasey's work involves a review of functions of the Treasury Department and the Comptroller General with a view to developing recommendations for a revised plan of operations and an efficient organization. It was anticipated that Mr. Vasey's experience with the Bureau of Reclamation and previously with the Bureau of the Budget would be of considerable value in handling this unusual assignment.

RIO NEGRO dam and power plant in Uruguay, an outstanding example of durable concrete construction and modern engineering.

LA PAZ, Bolivia. Arrow points to Franklin D. Roosevelt Park, named in honor of the late president of the United States.



GETTING ACQUAINTED with reclamation projects and people, the author (inset) a Nebraska water resources advocate, made and planned this trip from June to December to learn of water users' interests and problems.

NEEDED—MUNICIPAL WATER

by MERL B. PEEK, Assistant Secretary-Manager, National Reclamation Association

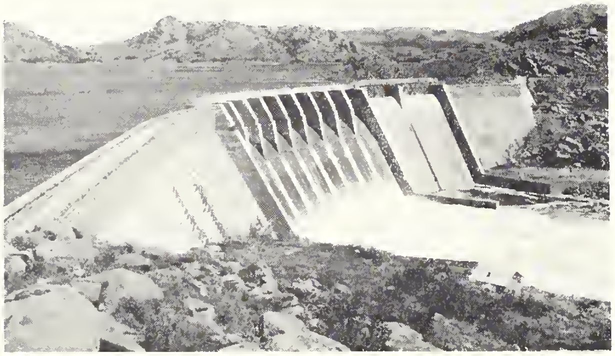
A visitor in the Great Northern Hotel at Devil's Lake, N. Dak., is immediately impressed with a sign posted in all rooms which warns its readers that water is scarce. It reads: Tap water, call room service, and drinking water will be delivered to you.

No wonder the people around Devil's Lake support the plan for the Missouri-Souris division, Missouri Basin project. Under this plan Sheyenne River waters will be diverted into the Devil's Lake Basin to replenish those lake waters which have been receding for the past 40 years. This new water will provide the Devil's Lake community with an unfailing source of municipal supply.

Similar municipal water-supply conditions prevail in many Western communities. People who are fortunate enough to be near a reclamation project have high hopes for ultimate relief through storage and canal facilities provided by the project. This demonstrates that municipal water supply is fast becoming a full-fledged partner with irrigation and power development in our present and future multiple-purpose projects.

The Collbran project, which will soon be before Congress for authorization, gives great promise to the residents of Grand Junction, Colo., for further population and industrial growth. However, before the city residents can enjoy project water, they must spend a substantial sum of money for an equalizing reservoir and a water-treatment plant. Too, they must contract for repayment with the Federal Government for the capital project costs allocated to municipal waters. The present plan calls for repayment in 60 years at 2 percent interest on that portion of the capital investment which is allocated to municipal water.

The residents of Pueblo, Colorado Springs, and other communities in the Arkansas River Valley are desperately in need of additional sources for municipal water. For that reason, and because of the opportunity for supplemental water for their already developed agricultural lands in the valley, great interest is shown in the first phase of the



ALTUS DAM—one of the Bureau of Reclamation projects which supplies municipal water. *Photo by P. W. George, Region 5.*

Gunnison-Arkansas project, commonly known as the Frying-Pan Diversion. The project plan will soon be ready for action by Congress.

Some 11 west Texas communities, including Amarillo and Lubbock, have found a solution for their critical municipal water needs in that booming defense area by the recent Congressional authorization of the Canadian River project. (See page 48 of this issue.) A statutory limitation on the amount of revenue bonds which Texas municipalities can issue forced these communities to turn to the Federal Government for financial aid. The greater portion of the estimated $85,000,000 costs will be repaid with interest over a 50-year period.

The proposed Anadarko (formerly the Fort Cobb) project in Oklahoma could furnish municipal water supply to the communities of Anadarko and Chickasha, Okla. The cost of delivering water to these two communities is estimated to be about 12 cents per thousand gallons. This revenue will permit repayment to the Federal Government of the entire capital costs allocated to municipal water supply in 50 years at 2 percent interest.

Rapid City, S. Dak., after a population growth of almost 100 percent to 26,000 persons in the past decade, is busy casting about for an additional municipal water source. Deerfield Reservoir, Rapid Valley project, located on Castle Creek about 27 miles west of Rapid City with its 15,700 acre-feet storage capacity is insufficient for the present City needs. The irrigation demands of some acres of land downstream in Rapid Valley for a portion of this storage further complicates the municipal water-supply problem. Steady pumping from city artesian wells has lowered the water level in an adjoining lake used by the State for a fish hatchery. The people in the project area commented very favorably on the proposed Pactola Reservoir as supplemental storage to relieve this situation which is rapidly becoming critical.

Residents of Belle Fourche, S. Dak., expressed their keen interest in the Wyoming-located Keyhole Dam and Reservoir on the Belle Fourche River as a water source to further the industrial expansion of their community.

Lemmon, S. Dak., city officials are busily engaged in negotiating with the Bureau of Reclamation officials for additional municipal water from the Shadehill Reservoir, on nearby Grand River. Several unavailing attempts to find new pumping sources for needed water have greatly discouraged the residents of this community.

People in Dickinson, N. Dak., mentioned with great satisfaction the rapidly filling reservoir behind the recently completed Dickinson Dam. The function of this storage is almost entirely dedicated to serving the municipal needs of this nearby community.

Under the proposed plan of development for the Missouri-Souris Division, diverted waters below Fort Peck Dam on the Missouri River would flow into the Souris Canal in northwestern North Dakota for the irrigation of over 1 million acres of lands. Municipalities located near the canal are counting on being supplied with water for municipal and industrial purposes.

Discouraging reports on the subsurface drainage aspects of the potentially irrigable lands in northwestern North Dakota, in the Crosby-Mohall area of the Missouri-Souris Division, have had an adverse effect on the communities located therein. Mayor C. S. Summers of Bowbells concisely stated the case by saying "our town has been short of a municipal water supply for more than 30 years." Many other communities in the Crosby-Mohall area are in a similar situation.

City officials in Tucumcari, N. Mex., are considering plans to participate in the use of stored waters behind Conchas Dam on the South Fork of the Canadian River. Altus, Okla., is receiving municipal water from the overflowing (summer, 1950) Altus Dam, W. C. Austin project, Okla.

The very existence of persons living in such Western metropolitan centers as Salt Lake City and Ogden, Utah; Phoenix, Ariz., San Diego and

Los Angeles, Calif., and El Paso, Tex., depends on Reclamation project water.

Historically, the Bureau of Reclamation was first authorized to supply water for municipal purposes by the Town Site Act 1906. Broader authority was granted the Bureau in the Miscellaneous Water Act, 1920. The Reclamation Project Act, 1939, also authorizes the Secretary of Interior to furnish water for municipal and industrial purposes either as a part of multiple-purpose projects or as single-purpose projects. The people need municipal water. THE END.

George S. Knapp Succeeded by Robert V. Smrha

Robert V. Smrha, new chief engineer of the Division of Water Resources, Kansas State Board of Agriculture (at left), with George S. Knapp, his illustrious predecessor. *Photo by Glenn S. Thomas, Office Engineer, Cedar Bluff Unit, Ellis, Kans.*

George S. Knapp, chief engineer of the division of water resources, Kansas State Board of Agriculture, and long an ardent reclamationist in that State, resigned on January 1, 1951.

During his long tenure of office with the board, dating back to 1919, he gained national recognition as an authority on water-resource development and served as executive secretary of the President's Northern Great Plains Committee during the drought of the 1930's. He served as secretary of the Missouri River States Committee since its organization and was the man most instrumental along with Senator Frank Carlson in inducing former Commissioner John C. Page to begin Reclamation investigations in Kansas.

Mr. Smrha (pronounced Smur–uh with accent on the first syllable) has been in the division since 1930, and senior engineer since 1937.

Bureau to Build Transmission Lines in South Dakota

Acting Commissioner of Reclamation Goodrich W. Lineweaver recently announced the award of contracts for the construction of a 520-mile transmission line grid in eastern South Dakota. Work on the lines is expected to begin immediately.

A similar advance construction program is already under way in North Dakota.

The transmission system will distribute low cost power which will be generated at plants in the Missouri River Basin. Ultimately more than 2,000,000 kilowatts of capacity will be required for the farms, communities, and industries of the region. Every effort is being made to step up construction of the system to meet emergency defense and other demands in power-short areas of the West.

Denver, Colo., contractors C. F. Lytle & Co. and R. N. Campsey Construction Co., and the Dallas, Texas B. & C. Construction Co. were awarded the contracts to build the 53 miles of 115-kilovolt transmission lines from Brookings to Watertown; 77 miles from Watertown to Groton and 90 miles from Groton to Huron.

The Orlando Construction Co. of Coleman, Wis., will construct 58 miles from Sioux Falls to Brookings, and 68 miles from Armour to a point near Fort Randall switchyard site and then to Gavins Point.

Approximately 84 miles from Huron to Armour and 89 miles from Gavins Point to Sioux Falls will be constructed by the Flora Construction Co. and Flora Engineering Co. of Denver, Colo.

The construction contract awards were made 15 days after the East River Electric Power Cooperative executed the contract with the Government for the power for distribution to its member cooperatives. (For earlier story see RECLAMATION ERA.—December 1950, p. 205.)

Sequim Project Dropped

As the result of a public hearing held on August 11, 1950, in Sequim, Wash., during which a preponderance of local opposition to the project was displayed, the Bureau of Reclamation is discontinuing investigative work on the potential 19,000-acre Sequim irrigation development near Port Angeles, Wash.

Wade H. Taylor Becomes Region 3 Power Director

Wade H. Taylor, who succeeds Roy V. Sprague as regional director of power in Region 3, will supervise all technical phases of the Reclamation hydroelectric program in the lower Colorado River Basin.

Mr. Sprague retired last July 1, at which time Mr. Taylor was assistant regional power manager. As a member of Regional Director E. A. Moritz's staff, Mr. Taylor will also head the branch of power utilization in the region. This branch has technical supervision over Bureau operations at Hoover, Davis, and Parker power plants and their integrated transmission systems in California, Arizona, and Nevada.

Mr. Taylor received his master of science degree in electrical engineering at Purdue University. He joined the Bureau of Reclamation in 1935 as junior engineer and has rapidly advanced through the ranks, becoming assistant regional power manager of Region 3 in 1945. •

All Eyes on Wind River

(Continued from page 52)

willow tree "spiders" were placed in the most critical stream bank erosion areas. Approximately 75 percent of the plantings have survived. Five sets of experimental seeding plots, including 21 species of various grasses and legume seeds, were planted under various conditions of elevation, site, soil, and moisture. The Bureau of Indian Affairs has conducted its experimental work on Five Mile Creek above the Riverton project where stream-bank erosion is aggravated only by natural flow. In a 1-mile strip various practices have been tested including fencing for livestock exclusion, bank sloping, tree planting, grass seeding, and the installation of live willow "spiders." All of these practices, either separately, or in combination, appear to be effective. The Bureau of Reclamation assignment was to make plantings on Five Mile Creek within the Riverton project where stream bank erosion has been severely accelerated by both normal flood flow and return flow from the irrigated project. A 1-mile section of the channel was selected where live cable trees, large willow "spiders" and tetrahedrons were installed. These practices were supplemented by planting willow and Russian Olive trees and seeding of sweet clover. The entire area was fenced to exclude livestock.

Investigating further methods of stream bank erosion control, the Geological Survey and the Bureau of Reclamation have mapped the bedrock exposures along the channels of both Five Miles and Muddy Creeks from their mouths to above the irrigated lands. This study has focused attention on the natural stabilization of the channel walls in the reaches where bedrock is exposed in contrast to rapid bank cutting where bedrock is absent. This information is now being supplemented by drilling where the bedrock is not exposed, and by obtaining center line profiles and cross sections of both streams. These three surveys will furnish the necessary background and investigations toward channeling the creeks to take advantage of bedrock locations.

To investigate the relative importance of soil losses from the range, studies are under way that will provide basic information as to the rate of erosion and soil losses from typical range areas under varying degrees of use and conditions. They will serve as a guide in carrying on future soil conservation and range-management programs.

The Geological Survey has a topographic mapping project under way that will eventually cover the entire basin. The basic and supplemental control has been completed, and preliminary maps are now available for the Riverton and Kinnear quadrangles.

The irrigation history and irrigation plans have been developed cooperatively by the Bureau of Reclamation and the Bureau of Indian Affairs. In this cooperative venture the Bureau of Reclamation is making the land classification, investigating storage facilities, and making the water-supply studies in cooperation with the Bureau of Indian Affairs. Canal, lateral, and appurtenant works investigations and tabulating information available on Indian irrigation developments are being done by the Bureau of Indian Affairs.

Ground-water and range-water development surveys are being conducted by the Geological Survey.

The Bureau of Reclamation is computing the total amount of soil which has been eroded from

WORLD LEADERS OF IRRIGATION AND HYDROELECTRIC DEVELOPMENT MEET IN INDIA

EASTERN CONGRESS—United States Commissioner of Reclamation Michael W. Straus, speaking at the opening of the World Irrigation Exhibition at New Delhi, India, on January 10, in connection with the Fourth Congress on Large Dams, the World Power Conference and the First Congress on Irrigotion ond Canals, ottended by over a thousand delegates from 30 nations. Listening attentively are (from left to right) Sir Vincent de Ferranti of Great Britain, chairman of the International Executive Council of the World Power Conference; Monsieur Andre Coyne of France, President of the International Commission on Large Dams; ond Shri N. V. Gadgil, India's Minister of Works, Mines, and Power. ***Photo through the courtesy of the Punjob Photo Service of New Delhi, India.***

the main channels of Five Mile and Muddy Creeks through the Riverton project, and has completed work on Five Mile Creek.

Preliminary economic surveys have been under way since the start of the Wind River investigations. The studies in progress show the relationship between the full and orderly development and utilization of land, water, mineral, forest, and human resources of the basin and its economic growth, which is the ultimate goal of the various development programs in the basin.

The Fish and Wildlife Service's contribution has been to investigate the fish and wildlife resources of the basin. Work to date has included investigations and reports in Bureau of Reclamation projects operating and proposed, Indian reservation wildlife inventory and production surveys, and comprehensive studies on lands of the National Forest, Bureau of Land Management, and private holdings.

The National Park Service and the Smithsonian Institution have conducted surveys and investigations to determine and appraise recreational, scientific, and history values of the basin. They will continue to study the effects of the Bureau of Reclamation project construction upon values and make recommendations concerning the conservation, use, and development of the basin's recreational, scientific, and historic resources.

The various agencies which have cooperated so wholeheartedly in making the Wind River Basin investigations a reality have accomplished during the past 2 years what was expected to take at least 5, and possibly 10 years. Many jobs remain to be completed, but the field committee now considers that within the next year to 18 months enough data will be available so that the complete plan for total basin conservation will begin to emerge. One of the last official acts of W. G. Sloan, retiring Chairman of the Interior Field Committee, was to reactivate a subcommittee to draft the final conservation report for the Wind River Basin. Members of this committee are: K. R. Melin, Department of Interior, chairman; Charles T. Hinze, Bureau of Reclamation; W. T. Vaughn, Bureau of Land Management; John M. Cooper, Bureau of Indian Affairs; and Thomas F. Hanley, Geological Survey. THE END.

WATER REPORT

By the first of February, Reclamation's water supply situation had not changed greatly since January. Reservoirs on most of the projects stored as much water as they usually do this time of year, with a few scattered exceptions, notably in the Southwest. Some of the reservoirs in the Columbia Basin and in western Nevada were releasing water to make room for spring floods. Runoff from the upper Colorado Basin was lower than usual for January, and Lake Mead was slightly below its normal level. The snow cover in the Great Basin was spotty. No relief from drought for the Salt River project and the Rio Grande. Missouri Basin reservoirs were at favorable seasonal levels, and no shortage of irrigation water was anticipated.

Here are the highlights of the water storage situation by regions (see map on back cover to locate areas):

REGION 1—Except for Oregon's Vale project, the reservoirs were storing enough water to take care of next year's irrigation. At Vale, although more than the usual amount of water flowed into the reservoir during the month, it was not enough to make up for last season's low hold-over. Vale project farmers had a poor prospect for abundant storage. On the other hand, the Anderson Ranch reservoir held nearly 300,000 acre-feet by the end of January—nearly as much as it contained at the end of the spring runoff last year.

REGION 2—Abundance was the word as of the first of February for all projects, including the Central Valley. Shasta Lake's inflow from October 1, 1950, to January 31, 1951, was 108 percent of the maximum record; Lake Millerton, 167 percent of the maximum. Irrigation farmers in the Sacramento Valley and on lands served by the Delta-Mendota canal should have abundant irrigation water to mature their crops. Only the lack of distribution systems limited the use of the abundant water supply on the lands served by the Friant-Kern and Madera canals.

REGION 3—Drought continued in Arizona, and there was very little snow cover in the high mountain areas. The Salt River was a mere trickle into Roosevelt Reservoir, reaching a record low for the fifth time in 6 months. The lands were very dry, and farmers must continue pumping water from wells. Lake Mead continued to have a large hold-over, and project farmers depending upon its supply had no worry about this year's irrigation season.

REGION 4—Water supplies ranged from fair to excellent. Very light snowfall probably means a "fair" forecast for Colorado's Mancos and Pine River projects. Prospects for Nevada's Newlands project and Utah's Weber River project were excellent. However, as on the Uncompahgre project, in Colorado, where heavy snowfalls on the watershed during the latter part of January changed conditions from very dry to about normal, a heavy spring snow could materially change the outlook. Dry soils in the valley and on mountain pastures may absorb much of the present moisture without affording much runoff, but should not affect the runoff from snow above the timberline.

REGION 5—The Rio Grande project continued to be drought-stricken. W. C. Austin's Altus Reservoir was almost full, with enough irrigation water for this year's crops. This project had a dry fall and winter, and there is a demand for water delivery early in February for wheat and preirrigation of potato land. Except for the Rio Grande project (where no stored water was released for irrigation during the whole month of January, and Elephant Butte Reservoir had the lowest January storage since 1919) all other projects within the region should have sufficient irrigation water for this year's crops.

REGION 6—and REGION 7—In both the upper and lower Missouri Basin the reservoirs contained satisfactory seasonal storage. Snow cover on the North and South Platte watersheds was above normal. In the valley areas, however, precipitation had been deficient for several months and soil moisture conditions were fair to poor. ●

CROPS

14,000,000 Tons of Food Produced on Reclamation Projects

In 1950 Reclamation projects scored the second highest record for production of food, forage, and fiber crops in its history—almost 14,000,000 tons. Total value of the year's production, which will go far toward meeting the needs of national defense and supple-menting the world food supply, ex-ceeded a half billion dollars.

This marks the eighth straight yea Reclamation crops have exceeded 10,000,000 tons and brings the tota production since 1943 to 102,000,00 tons.

Since 1906 when water was delivered to the first Reclamation project, it i estimated that 250 to 300 million ton of fruits, vegetables, cotton, suga beets, feed and forage for livestock have been produced on all projects.

Secretary of the Interior Oscar L Chapman, discussing Reclamation' crop record, said, "the record of cro production from federally irrigate lands is a striking example of the im portant contribution made by Federa reclamation to the food supply of th world and to the buying power of th Nation." ●

LETTERS

Idea Exchange

DECEMBER 5, 1950.

DEAR EDITOR: You have asked for i and as far as one interested reader o the November issue of RECLAMATIO ERA can go, you are going to get it.

Please enroll me at once as an avi respondent to your news offer. M wife and I are long-time owners of 12 acres of raw land lying under th Coachella Canal between Indio and L Quinta, Calif., a part of the Boulde Canyon Reclamation project. Thi acreage in the northwest corner of se tion 10–6S–7E, is classed as prime earl vegetable, grapefruit and date garde land, and it is our intent to develop i after the best advice and plans that w can obtain, a sort of model, push-butto farm. Hence, your invitation fall upon most fertile soil.

The article by D. L. Brechner of th Columbia Basin project, entitled "Rol ing Laterals," appearing in the curren issue of ERA, caught my eye as a ver typical example of helpful contributio to reclamation success even though i concerns a problem materially differen from ours.

Obviously, we would be most aide by articles or bibliographies on th phases of desert land developing, be ginning with the raw land and leadin through the phases of clearing, level ing, irrigating and soil-building wit

descriptions of actual methods that experience in such areas as the Coachella Valley, has proven best.

The phrase in Mr. Brechner's article, "By redesign the manufacturers can correct this weakness when it appears," leads to a picture of widespread cooperation through your yet unnamed column that might prove of great interest and mutual benefit to both manufacturer and farmer. Ideas, good ideas, have a way of appearing to people at odd times and under a variety of circumstances.

They may appear to career farmers, or to designers in farm implement factories or even to retired professional engineer-farmers such as I look forward to being in a few years. American ingenuity has always been especially active in creating labor-saving devices. Would it not be well within the purview of your contemplated feature to act as a national thought exchange to encourage original ideas of farm labor saving, family comfort, land improvement, crop betterment, and marketing problems?

If such a field is within your scope, let me suggest a proposed feature that might readily be tested among your readers as to its value and breadth of appeal. I have in mind the many novel, and sometimes valuable, ideas that belong, under our patent and copyright laws, to the originator but which, through lack of a medium to appraise and publish such discoveries, frequently are lost sight of or fall into hands which exploit the discoverer and the group to which he belongs.

Many of such ideas are developed and put into use by farmers who are motivated by no interest other than to improve their own lot and that of their neighbors. They are neither equipped nor do they desire to exploit a patent or a copyright as such.

What do you think about the value to our Nation of a service to farmers and friends of the Reclamation Service that would consist of checking with the Patent Office such ideas as would concern agronomy in arid areas to the end that originators could protect themselves and their group against lost or exploited ideas by dedicating patent rights and copyrights to a sort of national foundation or trust created for this purpose and by publication in your column, spread the ideas among those who may find them useful and, at the same time, protect them from outside appropriation and exploitation.

An additional incentive might easily be created through an annual award of a cup or medal by the President or some other high dignitary, together with several honorable mentions, to those who as a result of a poll among your readers, are deemed to have contributed the most to the welfare of reclamation communities.

Farmers are becoming increasingly mechanically minded and skilled, and are able to fashion many gadgets in a most economical manner. Manufacturers, too, would generally profit from a greater utilization of mechanical devices in raising the standards of American farm life through this tapping of a reservoir of original ideas.

As for your feature's name, it should bring to mind the good that may come to many through united effort, united thought—it must be short, significant, inspirational. Shall it denote the principle, or the process or the effect? "Think United" is an example of the first, "Seek and Share" is a process, "E pluribus bonum" might be a result, but distracting?

I recommend "Seek and Share" as being action and cooperative, akin to the Golden Rule.

Sincerely contributed,

L. Plitt Smeltzer,
4828 Glencairn Road
Los Angeles 27, Calif.

The Smeltzer suggestions are most welcome, and we hope our readers will comment and send in their ideas. We particularly like his idea of a national foundation or trust to ferret out patents and inventions of aid to irrigation farmers, and exchange the information among those concerned. The Era *will do its part, but this appears to be something which could be handled to great advantage by private, rather than public, agencies. The patent laws are designed to protect "lost or exploited ideas," and within our province, we plan to follow Mr. Smeltzer's suggestion by publishing descriptions of patented inventions which might be of value to irrigation farmers. The Patent Office publishes "The Patent Quarterly" which summarizes all items on which patents have been issued, and any of our readers who would be interested in developing Mr. Smeltzer's idea, with its ramifications of a Presidential award and stimulating manufacture of useful inventions, have our best wishes. Let us hear from more of our readers.—Ed.*

POSTSCRIPTS

How Nature Created Fertilizers

The story of creation was told in a very few words. And in somewhat similar, concise fashion Dr. Firman E. Bear of Rutgers University relates the earth's history, as seen by a soil scientist, in just two paragraphs:

"The earth came into existence some 2 billion years ago. A billion years passed before even the simplest forms of life came into being, and it took another 700 million years for flowering plants to evolve. The primitive forms of man did not arrive on the scene until a mere million years ago.

"During the 2 billion years of the earth's existence, gigantic forces were at work tearing the rock to pieces, leaching out the soluble salts, carrying them out to sea, and laying down large deposits of them on the bottoms of the oceans. In addition, atmospheric nitrogen was being combined with carbon, hydrogen, and oxygen on a tremendous scale to form organic matter."

As Dr. Bear points out, this great leaching process was not as wasteful as it might sound. Perhaps there was method in nature's seeming madness because large quantities of these rock-derived materials were shoved up out of the oceans through earthquakes and other natural forces. Such deposits, including many billions of tons of phosphate rock, potash salts, nitrate of soda, limestone, sulphur, and borax, are now being mined and put back on the land in the form of commercial fertilizer. Nitrogen is also being taken from the air, combined with other elements and used to enrich the land.

Were it not for these tremendous natural reserves of minerals and their availability for use as fertilizers, the future task of producing food for the earth's increasing population would be an almost hopeless one. Even in Montana and Wyoming, where soils are relatively rich in most of the elements that are essential for crop production, there is increasing use of fertilizers year after year, particularly on irrigated land. *(From July 1, 1950 issue of the Montana Farmer-Stockman, p. 7.)*

NOTES FOR CONTRACTORS

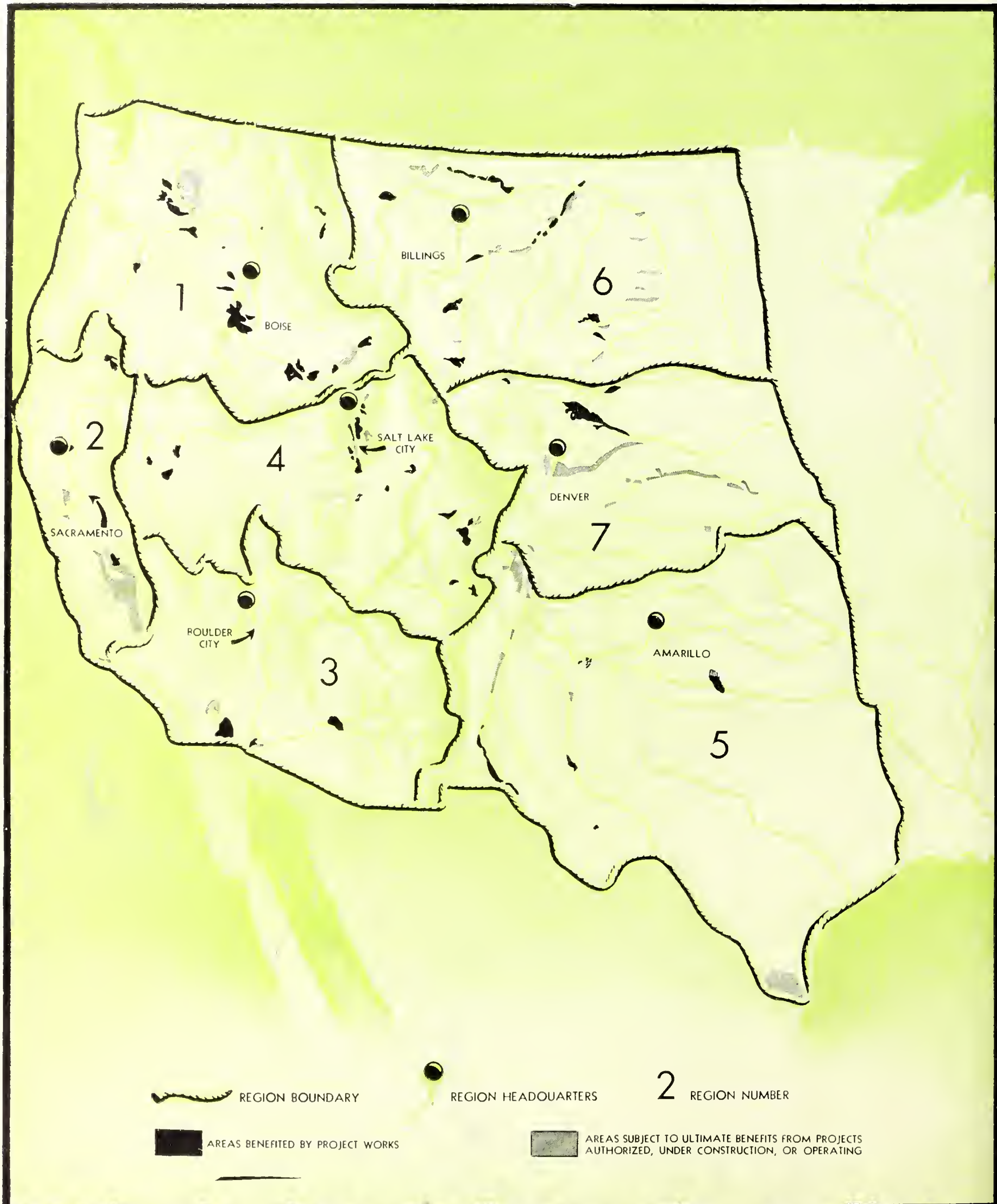
Contracts Awarded During January 1951

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DC-3204	Central Valley, Calif	Jan. 11	Furnishing and installing three 60,000-kilovolt-ampere vertical-shaft generators for Folsom power plant.	Westinghouse Electric Corp., Denver, Colo.	$2,550,185
DS-3226	Rio Grande, N. Mex	Jan. 16	1 46,000-volt circuit breaker for Albuquerque substation, schedule 2.	do	10,845
DS-3230	Minidoka, Idaho	Jan. 18	1 spare turbine runner for units 1 to 4, Minidoka power plant	Allis-Chalmers Manufacturing Co., Denver, Colo.	14,800
DC-3231	Columbia Basin, Wash	Jan. 16	Miscellaneous architectural finishes for right and left control bay, power plant, and elevator towers at Grand Coulee Dam.	A. Ruud, Spokane, Wash	64,972
DC-3235	do	Jan. 19	Construction of West Canal-Frenchman Hills tunnel	United Concrete Pipe Corp. and Ralph A. Bell, Baldwin Park, Calif.	2,175,315
DC-3236	Central Valley, Calif	Jan. 9	Construction of earthwork, pipelines, and structures for lateral 93.2W and lateral 93.2E, and sublaterals, Lindmore irrigation district, Friant-Kern Canal distribution system.	Steve P. Rados, Inc., Los Angeles, Calif.	666,187
DS-3239	Colorado-Big Thompson, Colo.	Jan. 3	4 3- by 3-foot outlet gates with 4 hydraulic hoists and six conduit liners for Carter Lake Reservoir.	Willamette Iron & Steel Co., Portland, Oreg.	34,868
DC-3243	Missouri River Basin, S. Dak.	Jan. 12	Construction of 127 miles of Sioux Falls-Brookings and Armour-Fort Randall-Gavins Point 115-kilovolt transmission lines, schedules 1 and 3.	Orlando Construction Co., Coleman, Wis.	937,086
DC-3243	do	do	Construction of 173 miles of Huron-Armour and Gavins Point-Sioux Falls 115-kilovolt transmission lines, schedules 2 and 4.	Flora Construction Corp., and Flora Engineering Co., Denver, Colo.	1,338,304
DC-3244	Colorado-Big Thompson, Colo.	Jan. 5	Construction of earthwork, concrete canal lining, and structures for Poudre supply canal, Windsor section.	Paul G. Van Sickle Corp., Denver, Colo.	239,269
DC-3246	Missouri River Basin, S. Dak.	Jan. 10	Construction of 220 miles of Brookings-Watertown-Groton-Huron 115-kilovolt transmission line.	C. F. Lytle Co., R. N. Campsey Construction Co., and B & C Construction Co., Denver, Colo.	1,865,306
DC-3249	Rio Grande, N. Mex.-Tex	Jan. 4	Construction of Lucero Arroyo dike, wasteway channel, and structures.	Lee Moor Contracting Co., El Paso, Tex.	47,797
DS-3250	Hungry Horse, Mont	Jan. 26	Fabricated structural steel for take-off structure at Hungry Horse power plant.	Virginia Bridge Co., Denver, Colo.	26,775
DS-3253	Boulder Canyon, Ariz.-Nev.	Jan. 9	1 lifting beam and 1 jacking frame for unit A9, Hoover power plant.	Star Iron & Steel Co., Tacoma, Wash.	17,850
DS-3255	Missouri River Basin, Wyo.	Jan. 16	1 12- by 15-foot ½-inch bulkhead, 3 6-foot 9-inch by 10-foot 2⅛-inch bulkhead gates, 1 lifting beam, 2 bulkhead frames, and 6 bulkhead gate frames for Boysen power plant.	Southwest Welding & Manufacturing Co., Alhambra, Calif.	21,040
DS-3262	Hungry Horse, Mont	Jan. 22	Fabricated structural steel for 230-kilovolt switchyard and transformer circuits for Hungry Horse power plant.	B. Katchen Iron Works, Inc., Newark, N. J.	38,530
DS-3264	Columbia Basin, Wash	Jan. 30	16,000 barrels of bulk portland cement for construction work in vicinity of Grand Coulee Dam, schedule 2.	Spokane Portland Cement Co., Spokane, Wash.	68,160
DC-3267	Missouri River Basin, Wyo.	Jan. 31	Construction of 84 miles of Thermopolis-Lovell 115-kilovolt transmission line and 18.6 miles of Garland-Lovell 69-kilovolt transmission line.	J & J Construction Co., Oklahoma City, Okla.	842,141
DS-3270	Eklutna, Alaska	Jan. 26	One 3,000 kilovolt-ampere package-type substation for Palmer substation.	General Electric Co., Denver, Colo.	37,728
100S-109	Minidoka, Idaho	Jan. 4	Seven 2,300-volt motor control units for pumping units at wells, North Side Pumping Division.	Afton-Lemp Electric Co., Boise, Idaho.	29,952
117C-86	Columbia Basin, Wash	Jan. 5	Construction of permanent residences, utility building garages, driveways, and utilities at O. & M. sites, schedule 1.	Westover and Hope, Quincy, Wash.	10,357
117C-86	do	Jan. 3	Construction of permanent residences, utility building, garages, driveways and utilities at O. & M. sites, schedule 2.	Commercial Builders, Inc., Moscow, Idaho.	11,244
117C-86	do	Jan. 3	Construction of permanent residences, utility building garages, driveways, and utilities at O. & M. sites, schedules 3, 4, 5, 6, 7, and 8.	Dale R. Peterson and Co., Inc., Seattle, Wash.	132,233
100C-113	Boise, Idaho	Jan. 25	Construction of East Hartley Gulch drain, Payette Division	James S. Trummell, Nyssa, Oreg.	47,890
200C-137	Central Valley, Calif	Jan. 8	Three-bedroom residences, Friant-Kern Canal, schedule 3	Dan E. Nelson, Fresno, Calif	23,638
200C-135A	Orland, Calif	Jan. 10	Lining portions of North and South Canals	Berlinger Corp., Chico, Calif	39,630
R2-127A	Central Valley, Calif	Jan. 8	Completion of electrical lighting installations at Shasta Dam	Vincent Electric Motor Co., Oakland, Calif.	27,656
R3-PX-52	Davis Dam, Ariz.-Nev	Jan. 8	Construction of operators' houses at Coolidge, Mesa, and Tucson substations, schedule 1A.	Mardian Construction Co., Phoenix, Ariz.	186,736
R3-PX-52	do	Jan. 4	Construction of operators' houses at Coolidge, Mesa, and Tucson substations, schedule 2.	Merle R. Gillespie, Casa Grande, Ariz.	13,006
300C-10	do	Jan. 19	Erecting a 75,000-gallon elevated tank at O. & M. system area	Pittsburgh-Des Moines Steel Co., Santa Clara, Calif.	33,810
300C-14	Boulder Canyon, Ariz.-Nev.-Calif.	Jan. 19	Alterations and additions to the water treatment plant at Boulder City, Nev	Drainage Construction Co. and James H. Huntley, Los Angeles, Calif.	133,009
600C-51	Missouri River Basin, Wyo.	Jan. 4	Clearing part of Boysen Reservoir site, schedule 4	Lindquist, Olsen & Co., Cambridge, Minn.	96,800
600C-52	do	Jan. 19	Clearing part of Boysen Reservoir site, schedule 1	Asbell Bros. Construction, Riverton, Wyo.	105,000
600C-52	do	Jan. 19	Clearing part of Boysen Reservoir site, schedule 5	Lichty, Brasel & Whitehead, Riverton, Wyo.	79,250
600C-52	do	Jan. 22	Clearing part of Boysen Reservoir site, schedule 4	Watkins & Pennington, Fort Collins, Colo.	92,050

Construction and Materials for Which Bids Will Be Requested by May 1951

Project	Description of work or material
Boulder Canyon, Ariz.-Nev.	Construction of steel frame warehouse, 9,600 square feet in area, at Boulder City, Nev.
Cachuma, Calif	Construction of 75-foot high, 100,000-cubic-yard earthfill Glen Anne Dam on the West Fork of Glen Anne Canyon, 4 miles northwest of Goleta, Calif.
Central Valley, Calif	10 motor-control switchgear and distribution switchboard units for Southern San Joaquin municipal utility district No. 3.
Do	Motor-control switchgear for 2,300-volt synchronous and induction motors for Trauger pumping plant.
Do	1 112.5-kilovolt-ampere distribution transformer for Trauger pumping plant.
Do	6 vertical-shaft, propeller-type pumping units, each of 33.3 cubic-foot-per-second capacity, for pumping plant No. 1; and 3 pumping units, each of 10 cubic-foot-per-second capacity, for pumping plant No. 2, Columbia-Mowry canal.
Do	Three 69,000-kilovolt-ampere transformers for Folsom power plant.
Do	4 vertical-shaft, turbine-type pumping units, 2 of 7 cubic-foot-per-second capacity and 2 of 3.5 cubic-foot-per-second capacity, for Exeter irrigation district pumping plant.
Do	6 potential transformers for Tracy switchyard.
Colorado-Big Thompson, Colo.	Construction of 90-foot high, 285,000-cubic-yard earthfill Rattlesnake Dam, 14 miles west of Loveland, Colo.
Do	Furnishing and laying 2,100-foot Pole Hill penstock, 2 5,850-foot Flatiron power plant penstocks, and 1,350-foot Carter Lake pressure conduit (Flatiron pumping plant discharge conduit).
Do	Main control board, supervisory control board, annunciator relay cabinet, distribution boards, battery-charging equipment, and station service transformers for Pole Hill power plant.
Do	Generator voltage bus structure and circuit breaker for Pole Hill power plant.
Do	Construction of Flatiron section of Horsetooth feeder canal, including 3.5 miles of concrete-lined canal, a 700-foot tunnel, and 2 500-foot siphons, 10 miles west of Loveland, Colo.
Do	1 13,000-horsepower synchronous motor for Flatiron power and pumping plant.
Do	Main control board, supervisory control board, and annunciator relay cabinet for Flatiron power and pumping plant.
Do	Motor-control boards, distribution boards, heating control boards, battery charging equipment, and station service transformers for Flatiron power and pumping plant.
Do	8 115-kilovolt disconnecting switches without grounding blades, 5 115-kilovolt disconnecting switches with grounding blades, and 1 115-kilovolt power circuit breaker for Flatiron switchyard.
Do	Construction of 400-cubic-foot-per-second capacity Willow Creek pumping plant, 2 miles of Willow Creek pump canal, and 7,500-kilovolt-amperes Willow Creek switchyard, 4 miles north of Granby, Colo.
Do	2 5,000-horsepower synchronous motors for Willow Creek pumping plant.
Do	69-kilovolt line panels, 480-volt station service unit substation, and supervisory control equipment for controlling Willow Creek pumping plant from Granby pumping plant.
Do	1 10,000-kilovolt-ampere and 1 500-kilovolt-ampere power transformer, 2 115-kilovolt, 600-ampere disconnecting switches, and 3 current and 3 potential transformers for Willow Creek switchyard.
Do	Construction of a concrete diversion dam and 12.4 miles of North Poudre supply canal extending northeast from the Cache la Poudre River, 18 miles northwest of Fort Collins, Colo.
Do	Main control board for Beaver Creek substation.
Columbia Basin, Wash	Construction of 91 miles of laterals ranging from 2 to 300 cubic-foot-per-second capacity to irrigate 20,000 acres in lateral area E-3 on East Low canal, 8 miles southeast of Moses Lake, Wash.
Do	Construction of 15.5 miles of 1,800-cubic-foot-per-second capacity unlined Potholes East canal and 5 miles of 1,800-cubic-feet-per-second capacity unlined Ringold wasteway, 6 miles southeast of Othello, Wash.
Do	Construction of a guard and fire house headquarters building for the city government of Coulee Dam, Wash.
Do	Grading streets, parking area, sidewalks, and lots; paving streets and parking area; constructing sidewalks, curbs, and storm-drainage facilities; installing street-lighting cable; relocating medical office building; and removing 13 buildings in Coulee Dam, Wash.
Columbia Basin, Wash	Construction of a 50- by 100-foot general purpose shop at Quincy, Wash.
Do	Construction of a building for housing radio receiving and transmitting equipment at Ephrata, Wash., and radio-equipment buildings at Quincy and Othello, Wash.
Davis Dam, Ariz.-Nev	Completion of architectural finish work and miscellaneous installations of equipment in Davis power plant, transformer deck and spillway structures.
Do	Construction of concrete spillway stilling basin at Davis Dam.
Do	Erecting steel structures and installing electrical equipment for Coebise substation.
Eklutna, Alaska	Construction of 4.4-mile, 9-foot diameter, concrete-lined Eklutna tunnel and surge tank.
Gila, Ariz	Construction of 15-mile, concrete-lined, 300 cubic-foot-per-second capacity Wellton canal.
Grand Valley, Colo	Construction of 3 precast concrete pipe siphons: 1,600 feet of 18-inch diameter pipe, 400 feet of 30-inch diameter pipe, and 4,000 feet of 60-inch diameter pipe.
Kendrick, Wyo	Construction of 3,750-kilovolt-ampere Rawlins substation.
Do	Construction of about 30 miles of Sinclair-Hanna 34.5-kilovolt transmission line.
Do	Furnishing and installing 2 18,950-kilovolt-ampere generators for Alcova power plant.
Do	2 160-inch turbine butterfly valves for Alcova power plant.
Paonia, Colo	Construction of 3.4 miles of 170 to 30 cubic-foot-per-second capacity Overland Canal, northwest of Hotchkiss, Colo.
Rio Grande, N. Mex	Construction of 52 miles of Belen-Willard 115-kilovolt transmission line.
Do	Construction of 7,500-kilovolt-ampere Willard substation, near Willard, N. Mex., and construction of Belen substation near Belen, N. Mex.
Missouri River Basin, Colo.	Construction of 3,000-kilovolt-ampere Julesburg substation.
Missouri River Basin, Mont.	4 51- by 34.5-foot radial-gate hoists for Canyon Ferry Dam.
Missouri River Basin, Nebr.	Construction of 11 miles of unlined and 2 miles of concrete-lined reaches of 685-cubic-foot-per-second capacity Courtland Canal, 4 miles southeast of Superior, Nebr.
Do	Construction of 16 miles of 36- to 6-cubic-foot-per-second capacity Courtland laterals.
Missouri River Basin, N. Dak.	Construction of 41 miles of Bismarck-DeVaul 69-kilovolt transmission line.
Do	Construction of 750-kilovolt-ampere Fort Clark substation.
Do	Construction of short distribution lines and small substations to serve the Fort Clark pumping plants near Stanton, N. Dak.
Do	Relocation of 2 miles of county road and raising a county bridge near Dickinson Dam site.
Do	Supervisory control and selective telemetering equipment for 12 substations controlled from Jamestown substation.
Missouri River Basin, S. Dak.	Approximately 6,300 tons of fabricated galvanized structural steel for bolted-steel towers for Bismarck-Mobridge-Oahe 230-kilovolt, single-circuit transmission line.
Do	Approximately 11,500 tons of fabricated galvanized structural steel for bolted-steel towers for Oahe-Big Bend-Fort Randall 230-kilovolt, double-circuit transmission line.
Do	Construction of 30 miles of concrete- and asphalt-membrane-lined reaches of Angostura Canal, 39 miles of laterals and sublaterals, and 21 miles of surface drains, about 10 miles southeast of Hot Springs, S. Dak.
Do	Construction of 10,000-kilovolt-ampere Woonsocket substation.
Do	Construction of 3,750-kilovolt-ampere Gregory substation.
Do	Construction of a camp at Shadehill Dam.
Missouri River Basin, Wyo.	Relocation of about 6 miles of U. S. Highway No. 14 at Keyhole Dam site, about 15 miles northeast of Moorcroft, Wyo.
Do	Construction of 15,000-kilovolt-ampere Lovell substation.
Do	Installing equipment in 15,000-kilowatt capacity Boysen power plant, and erecting steel structures and installing equipment for Boysen switchyard, 21 miles south of Thermopolis, Wyo.
Do	Construction of 6,000-kilovolt-ampere Sinclair substation.
Do	Construction of 2,000 feet of Alcova switchyard road.
Do	Grouting contraction joints at Kortes Dam, about 62 miles southwest of Casper, Wyo.

U. S. GOVERNMENT PRINTING OFFICE: 1951



THE RECLAMATION AREA

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BUREAU OF RECLAMATION OFFICES ____ Inside back cover

Ruth F. Sadler, *Editor*

Subscription rate $1 a year for persons residing in the United States and Canada; $1.50 a year for foreign subscriptions; special rate of 50 cents a year for members of water users' associations, and Bureau of Reclamation employees.

OUR FRONT COVER

THIRSTY TOTS Franklin Reese and his sister, Toni Annette, pause for a drink of the crystal clear and cool water from Thousand Springs, Idaho. See story, "Tapping Lost River" on page 66 of this issue. *Photo by Phil Merritt, Region 1 photographer.*

30 YEARS AGO IN THE ERA

The clouds are breaking in the West, spring has come, and the farmer is in his fields again, bravely facing the future and hopeful that when another harvest time arrives his present financial troubles will be alleviated. Recognition of his problems and methods aimed to put farming as an industry on a more stable footing are promised by our lawmakers and other agencies which are in position to be helpful. Meanwhile there is to be no letup on the part of the farmer to produce the food upon which the world depends.

(From "Current Comments gathered from the Project Press and People," by C. J. Blanchard, statistician, page 147, April 1921 issue of the RECLAMATION RECORD, predecessor of the RECLAMATION ERA.)

RECLAMATION PLACE NAMES IN THIS ISSUE

THE FOLLOWING COMMUNICATION from Secretary of the Interior Oscar L. Chapman to Acting Commissioner of Reclamation Goodrich W. Lineweaver on the occasion of the second annual construction engineers conference at Denver, Colo., February 12–16, 1951, is published as an indication of the role which the Bureau of Reclamation's construction staff will perform during the coming year.

UNITED STATES DEPARTMENT OF THE INTERIOR

Office of the Secretary

Washington, D. C.

FEBRUARY 12, 1951.

MY DEAR MR. LINEWEAVER: Please convey to the Conference of Construction Engineers of the Bureau of Reclamation at Denver this week the hearty congratulations of the entire Department of the Interior on the record of achievements they and their predecessors have made to the West, and for the conservation and use of its greatest single natural resource—water. The monuments to their skill and ingenuity range from the great multiple-purpose undertakings down through the single irrigation projects.

On the foundation the construction engineers have erected from the superb designs created under the direction of the Chief Engineer, Reclamation strengthened the Nation for the emergency that is upon us and bulwarked its domestic economy for the long pull. The projects of the 3½ million kilowatts of hydroelectric power now installed in Reclamation plants are serving the Nation today, as will the 7½ million kilowatts when presently authorized installations are completed.

Reclamation power is a bulwark of defense in these perilous times and the multiple-purpose phases of our developments will add further to internal security of the Nation.

Food, forage and fibre from the 5½ million acres of irrigated land served by Reclamation projects add to provisions for the West's expanding population. The 13 million tons of products from these lands will be increased proportionately as irrigation is extended.

Like all progress today, Reclamation must adjust itself to make the greatest possible contribution to the national defense.

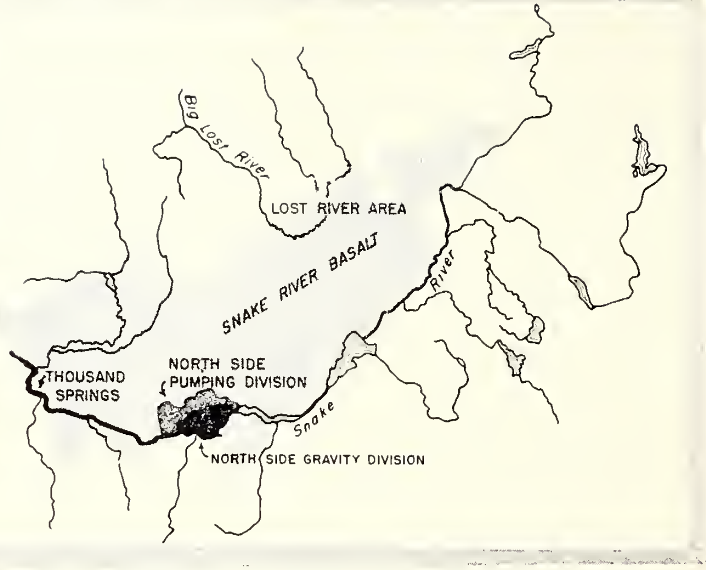
I am fully confident Reclamation's engineers and others of its staff will respond as always with the highest degree of cooperation.

Sincerely,

Oscar L. Chapman

Secretary of the Interior.

Tapping Lost River



SUBTERRANEAN SOURCES furnish refreshment to Fred McClellan on his North Side Pumping Division farm on the Minidoka project. The shaded area in the map above represents the basalt or lava bed where fugitive underground streams may provide a new-found water supply for Idaho farmers. ***Photo by Phil Merritt, Region 1 photographer. Map by Graphics Section, Washington, D. C., based on information submitted by the author.***

by HU BLONK, Regional Information Officer, Boise, Idaho

A GOOD PLACE TO START A STORY is at the beginning. This one begins about 1 million years ago.

It's the story of how the subterranean Lost Rivers of central Idaho are being tapped by the Bureau of Reclamation for irrigating 64,000 acres of land on the North Side Pumping Division of the Minidoka project—the first time on a large scale that the Bureau has gone underground for its source of water supply.

Briefly, the synopsis of the story is this. Four principal streams, generally referred to as the Lost Rivers, disappear into the lava beds between Arco and Mud Lake, Idaho. Some 125 miles southwest of where this phenomenon occurs, the water from the rivers, together with other underground water, reappears at the surface, in large springs. Between the places where the streams vanish underground and where they reappear, the Bureau is sinking irrigation wells, with results that indicate possibilities of some day making available to World War II veterans some 800 new homestead farm units on public land that now supports only sagebrush.

To elaborate, during the Ice Age, which began perhaps a million years ago, and ended about thirty thousand years ago, more or less, glaciers covered the slopes of the mountain ranges north of Arco. Melt-water poured out of these glaciers to form streams flowing southward onto the plain. They emptied into a prehistoric river, the ancestor of the Snake.

In the course of events, tremendous volumes of lava poured from volcanic vents in the central plain. Molten masses of lava flowed across the Snake River region, pushing the main river 50 or more miles southward from the place where it is today. The lava flow created a huge basaltic barrier in front of the rivers which had been flowing from the northern mountains into the Snake. Some of the individual basalt flows were as much as 100 feet thick. As one flow after another occurred, the mass in places grew to a thickness of 1,600 to 1,700 feet or more.

The trapped or frustrated streams which were blocked by the lava formation had considerable volume. They spread gravel for a few miles from the mountains southward over the lava. However, they could not cross the barrier on the surface. This is graphically illustrated by the Big Lost River, the largest of the disappearing streams. It was deflected from its course and now makes a 180° arc from south to north. The block-

ing action of the lava beds is also evident from the fact that for the entire 300 to 350 miles between Henry's Fork of the Snake to the east and the Boise River to the west, there is only one perennial northside surface stream that crosses the plain and reaches the Snake from the North.

However, the basalt was permeable, having large cracks, caverns, some crevices up to several feet in width, and other openings created by the cooling of the mass. As a result, the streams began to sink out of sight through the highly permeable gravel and through the network of fissures in the rock. That's where they are disappearing today.

Underground, the water from the rivers courses through the basalt and finally reappears, together with underground water from other areas, in the beautiful springs, which flow like waterfalls out of the north basalt wall of the Snake River Canyon in the 75-mile stretch between Milner Dam and Bliss, Idaho. Among these are the Thousand Springs. Long a tourist attraction, these springs are among the largest in the United States, if not in the world. The total discharge is estimated to average 5,000 cubic feet per second, or more than 3,600,000 acre-feet annually—about the same as the volume of the Missouri River at Helena, Mont., and more than the Rio Grande near Laredo, Tex.

The underground passage of water through the lava beds of central Idaho constitutes one of the great natural phenomena of the country.

The Bureau of Reclamation has been busy for the past 3 years probing this underground basin beneath the Snake River Plain. It has sunk 10 irrigation wells and 4 observation wells, reaching water at depths varying from 150 to 300 feet. A plentiful supply of water has been found. No matter how long the pumps operate there has been no appreciable drop in the water table. A careful check of the water table is being maintained by the United States Geological Survey through the observation wells and other wells nearby.

Some of the wells are among the largest in the country, delivering 7½ cubic feet per second. Ultimately, if the year-by-year trend indicates the feasibility of full development, 200 wells will pump water to the new area.

Irrigation on the project is already underway, about 1,233 acres being served from 3 of the 10 Bureau wells. Pumps will be installed soon on the remaining 7 to serve approximately 3,893 acres of additional land. Simultaneously with the Bureau development on public land, 20 wells, serving more than 12,000 acres, have been drilled and put in operation on privately owned land.

Despite glowing prospects, the Bureau is cautious about the underground supply. It does not

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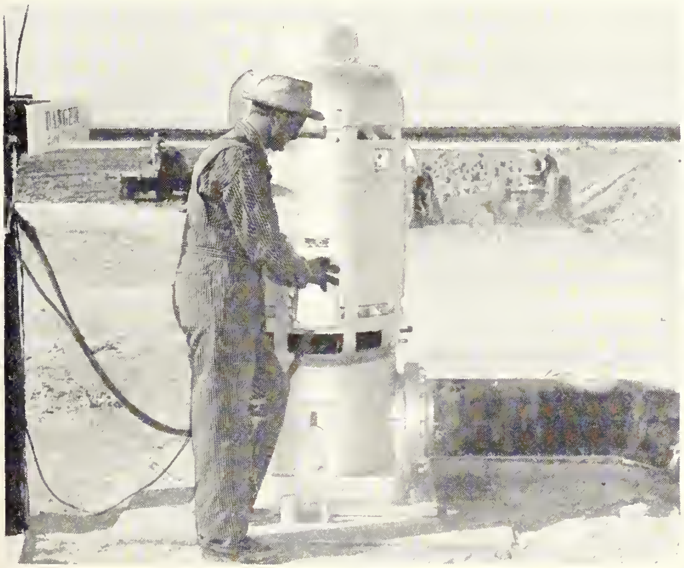
PROBING FOR PRODUCTION—Below, Blaine Hodges examines a Bureau pump which went underground to find water for irrigating the productive field in the background. At right, Dean Rector displays a first-year sugar beet, watered with the underground supply delivered through a private well. ***Both photos by Stan Rasmussen, Region 1 photographer.***



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WRAPPING UP Mirage Flats contract. Regional Director Avery A. Batson; Andrew F. Young, President Mirage Flats Irrigation Board; George Hurst, Board member, and Albert Richardson, Board Secretary. Above, good stand of brome grass on the banks of Mirage Flats project lateral.

Mirage Flats Takes Over

On every kitchen cupboard door of the Mirage Flats in Nebraska is proudly displayed a copy of a contract between the farmers and their Government. At least, this was what the people planned when they asked for extra copies of the document for each farm home.

This contract was signed on December 28, 1950, at the Mirage Flats Community House where settlers gathered to witness the ceremony during which their chosen officials, members of the Mirage Flats Irrigation District Board, affixed their signatures to a document which they had helped to draft, and which stated their willingness to take over the operation and maintenance of the facilities of the project and would begin repaying the United States Government for the construction costs.

Avery A. Batson, director of Region 7 for the Bureau of Reclamation, was delegated to sign in behalf of Oscar L. Chapman, Secretary of the Interior. Signing for the District were: Andrew F. Young, president, and Al Richardson, secretary-Treasurer. The third member of the board is George Hurst.

Many people took notice of the "running start" taken by the Mirage Flats settlers. United States Senators Kenneth S. Wherry and Hugh Butler, and United States Representative A. L. Miller sent telegrams of congratulations which were read to the group by the District's president. Mr. Batson read the following communication from Washington, D. C.:

I have read the proposed contract between the people of the Mirage Flats Community and their Government for the supplying of irrigation water to them. It demonstrates to me the splendid manner in which the people of the community, especially the Irrigation District Board and your representatives, have agreed on this mutual effort. You will recall that negotiations for a repayment contract started in 1948. Prior to that time and up to the present time, water has been delivered to individual water users under water rental arrangements. The operation and maintenance of the project was carried on by Government employees.

With the signing of the contract, the people of the Mirage Flats will take over the operation and maintenance of the facilities and will commence repayment of construction costs to the United States. That is indeed good news to me and I know it will be good news to the Congress. It is further exemplification of the great faith which the people of America have placed in the West and in the water users. Willingness to repay the Treasury of the United States a fair share of the cost of water resource development assigned to irrigation is a basic precept upon which Reclamation was founded.

Mirage Flats project is an excellent example of what cooperation between the people and the Federal agencies can accomplish. Through the Department of Agriculture the Government acquired title to all but eight tracts of land within the project area. These tracts were allotted to individual farmers with priority given to World War II servicemen. It is a modern realization of the dreams of your western Nebraska pioneers.

The start of irrigation upon Mirage Flats is indeed one of the great sagas of the history of Nebraska. Its imprint should reach deep into the minds and hearts of every citizen of the State. I congratulate the people of Nebraska and the people of Mirage Flats Irrigation District upon this achievement. My only regret is that I cannot at this time come to western Nebraska and personally sign the contract on behalf of the Government of the United States.

Accordingly, I hereby delegate that authority to you [Mr. Batson] and urge that you express to the people my sincerest congratulations.

Sincerely yours, OSCAR L. CHAPMAN,
Secretary of the Interior.

Ernie House of Ainsworth, Nebr., president of the Nebraska Reclamation Association and also president of the Niobrara River Development Association, spoke to the settlers, as did Mr. Vern Lindholm, also of Ainsworth, secretary-treasurer of the Niobrara River Development Association. Clyde Burdick, the Bureau's area planning engineer, of Ainsworth, was an interested spectator. He had helped build the project.

"The Mirage Flats project is one of the many important projects included in the long-range program for the development of the land and water resources of the Missouri River Basin," Batson told the more than 300 persons gathered at the Community House.

"Box Butte Dam, Dunlap Diversion Dam on the Niobrara River, major features of the project, plus the miles of canals, laterals and siphons constructed by the Bureau of Reclamation in northwestern Nebraska, will play a major role in alleviating the economic uncertainty of the region.

"Provision has been made for the storage and control of water used to irrigate approximately 12,000 acres of semiarid land. Irrigated farms on the project are already producing quantities of alfalfa in excess of their needs—more even than will be needed under anticipated increased development of livestock feeding programs.

"Mirage Flats played an important part in supplying feed to cattlemen in northwestern Nebraska during the 1948–49 blizzard.

"Its surplus feedstuff, available to cattlemen, adds to the stability of the State's beef-producing industry. Since the initiation of irrigation on Mirage Flats, potatoes, barley, beans, and corn have become money crops and high individual yields have been produced by the project's new farmers.

"No longer are the descendents of the hardy pioneer settlers in the Mirage Flats area dependent upon the vagaries of season and weather for what was, at the best, a precarious living.

"A foundation for a sound, secure agricultural economy was laid when the Mirage Flats project was completed and placed in operation. Signing of the repayment contract places its actual operation in the hands of the people of the area and assures the repayment to the Government of their fair share of construction costs.

"Today the Mirage Flats project is in operation. Settlers who took up the available farms are constructing new houses and other necessary buildings. Mirage Flats is no longer just a 'mirage.' It is a reality!"

(See the January and February 1950 issues of the RECLAMATION ERA for Parts 1 and 2 of "Mirage Flats Project"—Editor's note.)

After the formal signing portion of the ceremony the group engaged in a question and answer period, and decided to employ Earl Winchell, a Bureau of Reclamation employee at Guide Rock, Nebr., as the District's project superintendent.

On January 1, 1951, the Board took over the project, starting a new year, right, by getting off to a good start in operating what a former commissioner of Reclamation, Harry W. Bashore, in 1948 called, "the best looking 3-year-old project" that he had ever seen in his life. It is even better looking now. THE END.

O. S. Warden, Reclamation Leader, Dies

O. S. Warden, a key figure in Western Reclamation development for a half a century, died at his home in Great Falls, Mont., on March 12. He was also publisher of the Great Falls Tribune and a director of the Associated Press.

As one of the first presidents of the National Reclamation Association, serving from 1935 through 1944, he contributed greatly to the overall expansion of the Reclamation program. Among specific projects for which he is particularly responsible is the Canyon Ferry Dam, a unit of the great Missouri River Basin.

His statement "The court of public opinion is making up a verdict. The Nation, I think, is aware. If we have a new prosperity, industry and agriculture—both will take their places as cornerstones. Reclamation will then be secure," made during his second year as president of the National Reclamation Association, in the dark days of the depression, best expresses his faith in Reclamation and its future.

Reclamation's Hall of Fame

Nomination No. 11

W. G. SLOAN

CO-AUTHOR OF THE MISSOURI RIVER BASIN PLAN

"IMAGINATIVE PLANNING * * * farsighted vision * * * distinguished service * * * leader in the field of conservation and fact-finding * * *" are terms used by Secretary of the Interior Oscar L. Chapman in describing W. G. Sloan, nationally renowned Bureau of Reclamation engineer and author of the original "Sloan Plan" for the multipurpose development of the Missouri River Basin, who retired from Government service on December 31, 1950.

Before his retirement, as chairman of the Interior Missouri Basin Feld Committee, Mr. Sloan had seen his multipurpose plan for the development of the water resources of the Missouri River drainage basin materialize, with 15 major dams completed or under construction and thousands of acres of dry land ready for irrigation.

As chairman of the field committee, with headquarters at Billings, Mont., Mr. Sloan was in charge of the coordination of the work of the seven Interior Department agencies participating in the comprehensive development program. Until his retirement, he was the representative of the Interior Department on the Missouri Basin Interagency Committee—a group composed of the representatives of the 5 Federal departments interested in the basin development and 5 governors representing the 10 Missouri Basin States affected by the development plan. He had headed the field committee from the time of its inception in January 1947. He had been a member of the interagency group since September 1946 and served as chairman of the group from April 1949 through June 1950.

Prior to his departure for San Diego, Calif., Mr. Sloan was feted at a round of dinners and luncheons.

At North Platte, Nebr., on December 1, Sloan was honored at a luncheon attended by governors or their representatives from the Missouri Basin area and representatives of the Federal departments participating in the basin-wide program. The highlight of this luncheon was the presentation, by Assistant Secretary of the Interior William E. Warne, of the Interior Department's highest honor—the Gold Medal Award for Distinguished Service. At this meeting one of the Omaha World-Herald staff members described W. G. Sloan as "a man whose imprint on Missouri Basin history is etched deeply."

In a brief talk, Sloan indicated his heart would be in the Missouri Basin and the development program which his foresight and engineering ability helped start. Mr. Sloan's voice broke with emotion as he described his work on the Missouri Basin program as "10 of the happiest years of my life," according to the World-Herald reporter.

At Denver, Colo., on December 14, Mr. Sloan was feted at a dinner held by the members of the Interior Missouri Basin Field Committee at which the Bureau of Reclamation's Chief Engineer L. N. McClellan was one of the principal speakers and A. D. Molohon, Regional Director, Bureau of Land Management, Billings, Mont., was toastmaster.

Friends and coworkers of Mr. Sloan in the Bureau of Reclamation, including K. F. Vernon of Billings, Mont., director of the Bureau of Reclamation's Region 6, and former Regional Director H. D. Comstock honored the retiring engineer at a dinner December 27 at Billings. Participating in the dinner event were representatives of the Bureau of Land Management, Bureau of Indian Affairs, Fish and Wildlife Service, National Park Service, and United States Geological Survey.

On January 5, the Reclamation associations of Montana, Wyoming, and North and South Dakota sponsored a testimonial dinner at the Billings Commercial Club to honor Mr. Sloan. More than 100 friends from the Missouri Basin area were on hand to laud the retiring engineer and almost 200 more sent letters of tribute. W. W. Gail of Billings was toastmaster, and H. L. Buck, secretary of the Montana Reclamation Association, was in charge of arrangements for the event.

Mr. Harry E. Polk of Williston, N. Dak., president of the National Reclamation Association, recalled in his address that Mr. Sloan first unfolded his plan for the Missouri River Basin at the first annual meeting of the North Dakota Reclamation Association at Minot 10 years ago. The speaker pointed out that "Mr. Sloan's plan for the basin-wide resource development was the first and was followed by similar plans for the Colorado River, the Columbia and other major river basins."

Brig. Gen. S. D. Sturgis explained that "Glenn Sloan's plan for the economic development of the Missouri River Basin is not only a matter of great importance in time of peace, it is of vital importance to the Nation in the critical years ahead." He commended Mr. Sloan for having the courage to conceive his plans for the Missouri River Basin and the courage to present these plans. He explained that "it is not only an engineering plan, but a plan of great social significance."

In presenting a lifetime membership in the North Dakota Reclamation Association to Mr. Sloan, R. L. Dushinske, president of the North Dakota Reclamation Association, explained that his tribute came not only from the 15 North Dakotans who were in attendance, but "represents as well the gratitude of the entire State of North Dakota."

H. L. Halvorson of Minot, N. Dak., pioneer North Dakota reclamationist and official of the Missouri-Souris Projects Association, said, "Glenn Sloan taught us the possibilities of resource development and what can be accomplished in North Dakota through the use of the State's water resources. I want to thank you [Mr. Sloan] for all you have done for our great State."

Speaking of the structures erected, under construction and planned in the Missouri River Basin, as a part of the Missouri River Basin project, Raymond F. Lund, former president of the South Dakota Reclamation Association, referred to them

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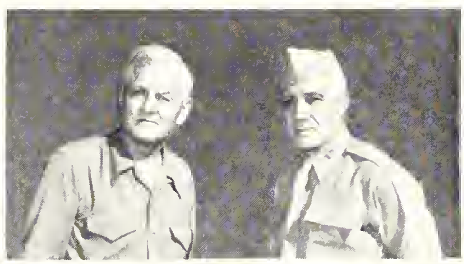


MISSOURI BASIN PLANNERS W. G. Sloan and Maj. Gen. Lewis A. Pick, right, authors of the famous Pick-Sloan plan for putting the Missouri to work. Sloan, Senator Butler of Nebraska, and Commissioner of Reclamation Straus at Trenton Dam dedication. Assistant Secretary of Interior William E. Warne reads citation as Gov. Val Peterson of Nebraska pins Gold Medal on Sloan. ***Photos by Norton T. Novitt, Region 7 photographer.***

New Clover Boon to Livestock

A CLOVER THAT GROWS IN THE WINTER and is ready for heavy pasturing early in the spring, earlier than common forages, sounds interesting, does it not? Subterranean clover, or subclover for short, meets those requirements and the announcement of an improved strain of this legume at the Oregon experiment station has emphasized its possibilities.

Nangeela is the name of the new subclover. It was brought in from Australia and planted at the Oregon station, where it was observed for 10 years before its recent release to the public. Previous to this time, Mount Barker, a midseason type, and Tallarook, medium late, have been the preferred strains but Nangeela, which is winter-hardy, fast-growing and an excellent producer of both forage and seed, excels both of them. It is ready for spring grazing earlier than Mount Barker and it grows as late in the summer as Tallarook but it matures seed about as early as Mount Barker. Moreover the new kind has distinct leaf markings that make identification easier and more exact than with the other varieties. Seed increase plantings have been made for 2 years, both in 1949 and in 1950.

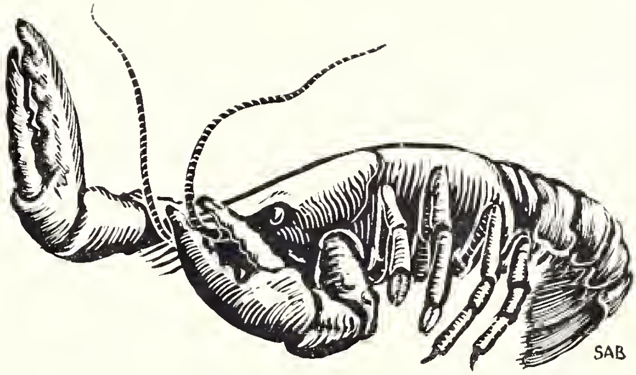
The first planting of subclover in Oregon, and one of the first in the United States was made (with seed which also came from Australia) in 1922. The forage commanded very little attention, however, until 1937, when dairymen in western Oregon began to recognize its value. Since then they have taken to it in large numbers and, at the moment, they have 100,000 acres of pasture consisting of subclover mixed with grass-rye grass, orchard grass, one or more of the fescues, or Highland bentgrass. Oregon extension service people say that in the future the acreage will multiply more rapidly and that in another 10 years the Willamette Valley will have 1,000,000 acres of subclover, an amount equal to half of its total pasture acreage. Eighty-five percent of the farmers in Marion County, Oregon, already have 10 to 15 acres each in subclover and alta fescue. They never had good pasture early in the year before. When the clover stops growing, they have supplemental grass to use until the clover gets started again.

This nutritious legume is an annual but, when given a chance, it reseeds itself year after year. Subclover is established by planting 8 pounds per acre of inoculated seed alone, or 3 pounds with 15 pounds of grass seed, in September. In Oregon the crop is treated with gypsum and treble superphosphate in the spring. Growth is rather slow at first, during the fall and winter, but toward spring it picks up and begins to produce a mass of growth, which is available continuously for heavy grazing until late June or early July, when the plants mature their seed and die. In the fall the seed germinates and another year's crop thus is started.

Subclover buries its seed heads beneath the vegetative mat that the plant forms, which is the reason it is described as subterranean. When the seed is harvested a 5-foot lespedeza cutter bar is used, tilted forward, to pick up the heavy clover plants. The mower knife is operated at a high speed. Standard stationary separators are used to thresh the seed.

Crops people who have seen subclover expect, on the basis of its performance, that in time it will be distributed widely from Oregon to other States. It is adapted wherever winters are moist and mild. They believe it will become important as a pasture crop all along the west coast and in the South. Subclover seed for trial has been sent from Oregon to a number of southern experiment stations.

(Reprinted from the October 1950 issue of "The Northwest," official monthly publication of the Northern Pacific Railroad.)



BELLE FOURCHE VS. CRAYFISH

Today's Battle Against Canal Saboteurs in South Dakota

by W. N. PARMETER, Settlement Specialist, Missouri-Oahe District, Huron, S. Dak., and FRED C. WINKLER, Project Manager, Belle Fourche project, Newell, S. Dak., both of Region 6 (headquarters at Billings, Mont.)

THERE IS NOTHING BACKWARD about the vicious chiseling of "crawfishing" crayfish when it comes to damaging irrigation canals. These silent saboteurs dig by day and by night, and unless checked in their destructive work, are sure to bring about a leak in the dike! A battle is going on today at the Belle Fourche irrigation project, Newell, S. Dak., where crayfish have become a serious problem in the efficient operation of the canals and laterals. The Belle Fourche people are using some unique methods of eradicating and controlling these burrowing creatures.

The main damage occurs when these crustaceous "saboteurs" dig holes through ditch and canal banks and around irrigation structures, so that the bank or structure washes out if not repaired in time. In one case on the project, a hole 35 feet long, from the canal to a drainageway, caused a shutdown of irrigation activities until the canal could be repaired.

People say that the crayfish was introduced to the Belle Fourche irrigation project many years ago by an enthusiastic angler who wanted bait to catch big lake bass. He got some crayfish and planted them in an irrigation canal near his farm. The crayfish thrived, and multiplied. Today their anti-Reclamation activities cost the irrigation district about $5,000 in yearly damages to the project canals and structures.

The adult crayfish, 3 to 6 inches long, resembles a miniature lobster. He is of a dull greenish or brownish color, often diversified with a little pale yellow below and sometimes with a little red about the legs. He burrows into banks of streams and irrigation canals and lurks at his den opening with great claws ready for any unsuspecting passer-by. He eats bugs, roots, small fish or almost anything he can lay his claws on. He has four highly developed senses—sight, feel, smell, and taste. The fifth sense is missing; the crayfish is stone deaf. He feels his way in the dark with two sets of antennae. At the base of the short antenna are the balancing ears. If both ears are injured the crayfish will float upside down. Also near the base of the short antenna are the taste and smell bristles. The crayfish walks with its head foremost and swims with the tail foremost. If a crayfish's limb gets caught, bruised or broken, he (or she) sheds it and grows another one in its place.

In the autumn the mother crayfish makes a temporary nest by bending her tail forward, and "liberates" the eggs, like small unripe currants, into the nest. At the same time she glues the eggs into the basket with a secretion from the underside of her tail. When the eggs are firmly fastened to small paddlelike limbs called swimmerets, the male crayfish fertilizes them. The young are hatched

in the spring. A crayfish in the progress of its growth goes through eight moults the first year, five the second year, and two the third year.

Aromatic solvents are very effective in eradicating this pest. However, it is difficult and expensive to get rid of the crayfish completely, as all canals and ditches should be treated at the same time. This crafty little creature infiltrates into ditch banks and canal layouts. During the aromatic solvent treatment the flow of water must be reduced to about 1 cubic foot per second with a velocity of approximately 1 foot per second, and the attack should be made in the warm summer months before the crayfish burrows into the ground for the winter. When the water was low enough, we loaded a high-pressure sprayer with an aromatic solvent, placed a small orifice nozzle under water for 40 minutes, until the water was milky 200 feet downstream, and got good results. The concentration of the solvent in water should be about 550 parts per million.

Light charges of dynamite have also been used successfully in stopping leaks under banks, and small washouts around structures have been backfilled with gravel.

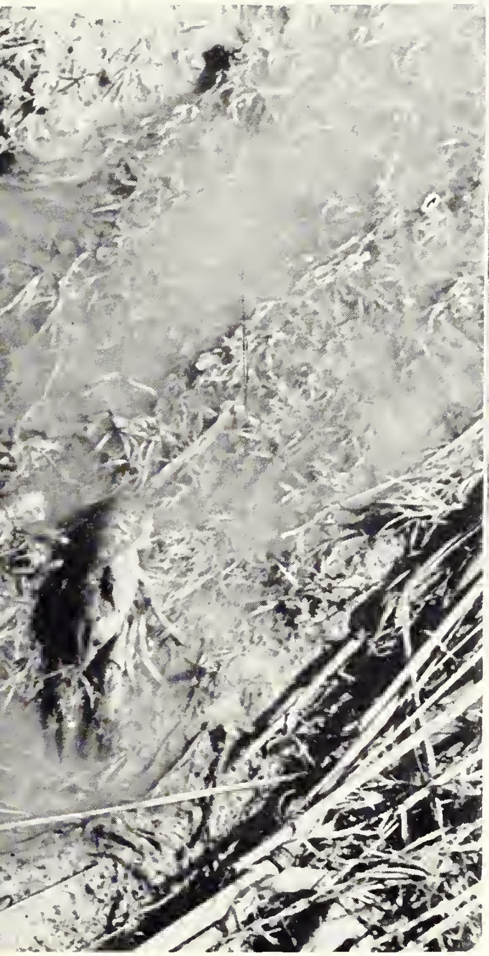
An effective control method of saving a structure or ditchbank where a washout has started is to fill the crayfish hole with a slippery or soupy cement mixture called grout. A satisfactory and inexpensive grout mixture is composed of one-fifth part cement and four-fifths topsoil with enough water added so the grout can be applied in a liquid form. The cement, topsoil, and water are placed in a mixing tank on top of a mud jack pump which has a 1¼ horsepower air-cooled gasoline motor. The motor does double duty—it furnishes the power to mix the grout and pumps it through a special nonclogging ball valve and a hose with a nozzle applicator. The grout is applied under a 20- to 40-pound pressure. The hose must be pushed into the crayfish holes so that the grout will fill every crevice, and seal each crayfish burrow down to the last nook and hideout. Solvent naptha is used in the grout mixture to kill any crayfish that may be trapped in the hole. From 1 to 70 cubic feet of grout have been used in repairing structures by this method.

In one instance, we had to repair two large drops that were threatened by numerous burrows and general undermining. This job required 110 cubic feet of grout made from 100 sacks of cement

at a cost of $173 for material, labor, and equipment. We did not have a mud jack pump at the time and had to use a duplex piston-type pump which was designed to handle only straight cement grout. Repairing these two drops by the old manual method, using hand shovels to dig out the honeycombed area, and refilling and packing down the excavation, would have cost $450. The same results could have been obtained for $94.70 by using part topsoil in place of cement in a ball valve mud jack pump which is now part of the equipment on the Belle Fourche project.

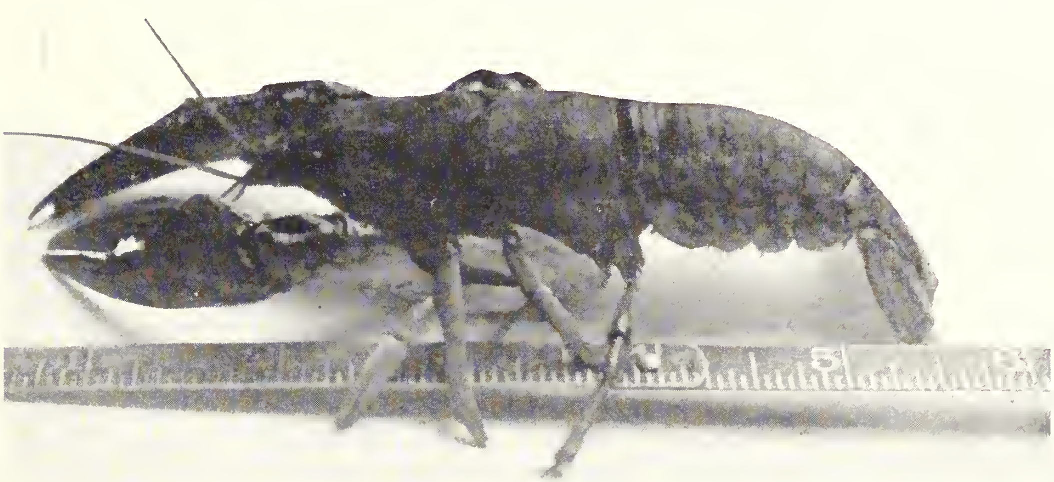
Again, necessity is the mother of invention. The Belle Fourche irrigation district has fully recognized the crayfish problem and is gradually winning its battle against this uninvited guest.

THE END.



PUBLIC ENEMIES driven into the open by solvent naphtha on Belle Fourche Irrigation District, at left. Ditchrider Victor Norlin using solvent naphtha (Dead-X) on crayfish in Townsite lateral. *Photo by F. C. Winkler, Region 6.*

CLOSE UP OF A CULPRIT—Adult crayfish below. *Photo by F. C. Winkler, Region 6.*



HE TOOK TIME TO SAVE TIME—John T. Maletic (left) worked after hours, nights and week ends to prepare time-saving formulas for weed control. Here, Regional Director Avery A. Batson congratulates him upon receiving the Department of Interior Honorable Mention Award for the achievement.

SHORT CUTS TO WEED KILLING CALCULATIONS

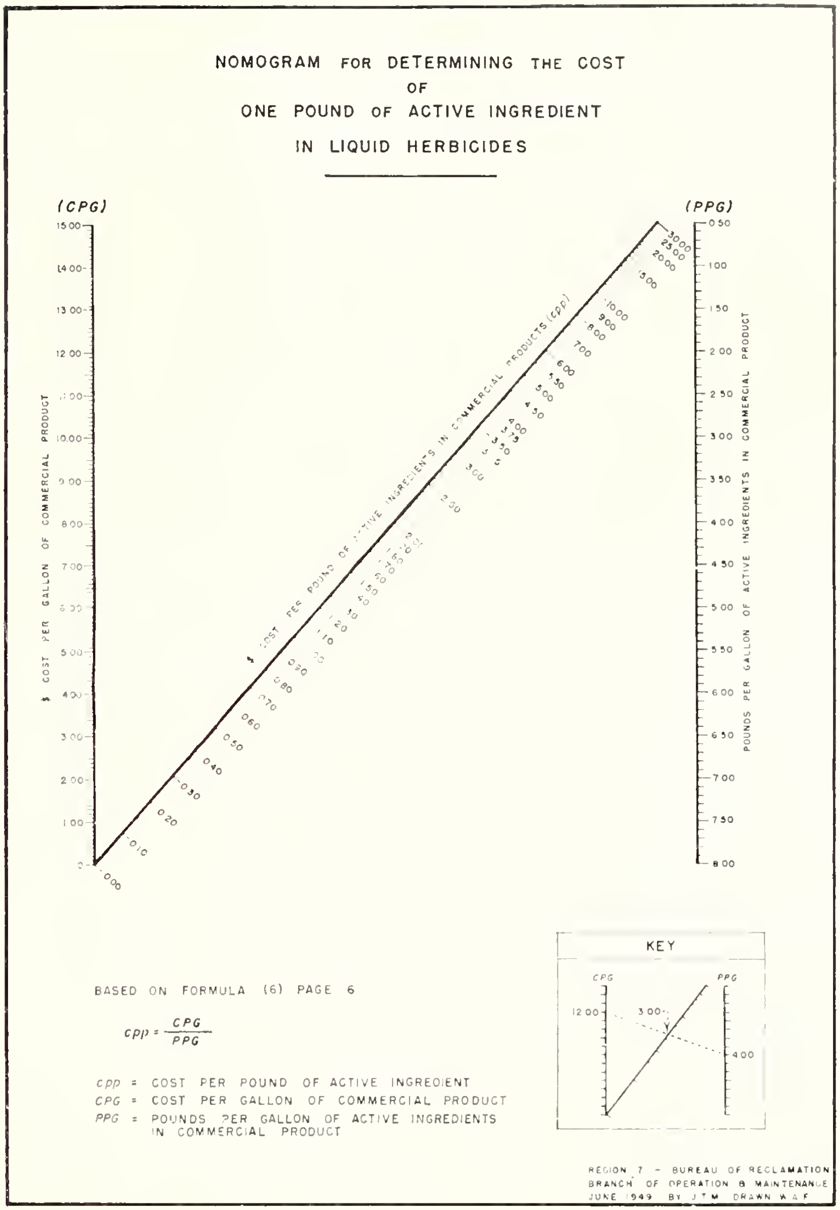
Suppose you want to get rid of some weeds, and someone advises you to spray them with 2,4-D. When you go to the store, there are half a dozen or more different varieties of 2,4-D staring you in the face, all with different price tags attached. Which one should you buy to get the most for your money?

This is one of the many questions which crop up during weed control time, and the answer to this one, plus many others, can be found in the handbook entitled, "Weed Control Calculations." by John T. Maletic (pronounced mah-*lett*-ic) of Denver, Colo., soil scientist and weed specialist of the Bureau of Reclamation's Region 7. Mr. Maletic, who wrote this book mostly on his own time, since his other duties kept him busy during his regular working hours, received a medal for meritorious service from Secretary of the Interior Oscar L. Chapman because of his outstanding achievements beyond his regularly required duties.

During the last few years a wide variety of chemicals and equipment have been devised to control weeds. Mr. Maletic wrote his handbook so Bureau of Reclamation officials and water users on irrigation projects could make the most of these compounds by preparing and applying the correct mixture, in the most effective manner, and at the lowest practicable cost. The 127-page handbook, "Weed Control Calculations" is primarily concerned with *how* to prepare and apply the new chemicals, both liquid and powdered types. Mr. Maletic's book does not contain information on *when* and *where* to apply the herbicides to get the best results. These items are also important in weed control work as the farmer can lose a great deal of time, effort, and money if he treats weeds at the wrong time, or uses a chemical to kill certain kinds of weeds only to discover that it has little effect in that particular area. The "when" and "where" to use different herbicides is often a local problem and advice on these points usually can be obtained from county agents, State and county weed experts and from weed control bulletins. However, the handbook has been helpful to the conscientious farmers and agents who were looking for information on how to choose the most economical chemical for the job, how to mix the chemicals, and how to figure the speed of the rig, the spacing and discharge rate of nozzles, how to apply the desired volume, and how to adjust the spray nozzles so the entire leaf surface of the weeds is drenched.

Proof of its popularity has been the demand for the handbook by members of private irrigation districts, county agents, State and county weed officials, chemical manufacturers and others who need

GETTING THE MOST FOR YOUR MONEY is made easy by using this nomogram. The word nomogram is the preferred modern spelling for the word nomograph which simply means a chart which you can use to find answers to problems without resorting to mathematical formulas. A straight edge, plus information on two items, will help you find the answer to the third item on this one, which is designed to help you find out how much each pound of active weed-killing ingredient costs when you buy it in liquid form. By law, the amount of the active ingredient must be stated on the label. If, as shown in the example in the key appearing in the lower right-hand corner of this monogram, the price per gallon is $12 (CPG scale) and the product contained four pounds of the active ingredient (see PPG scale), the price of the part that does the work will be found where a straight line drawn between these figures cross the diagonal line (CPP scale) which gives you the answer—$3 per pound. Now try it with your own ruler. Say a product costs $4.90 a gallon and contains 3.5 pounds active ingredient per gallon. Place your straight edge on 4.90 on the left-hand scale and 3.5 on the right-hand scale and you will find it crosses the diagonal scale at 1.40 which means that each pound of active ingredient costs $1.40 per pound. If another product costs only $4 per gallon but contains only 2.5 pounds of active ingredient you will find the chemical that does the work is costing you $1.60 per pound.



this information. Now several colleges use the book in weed control courses and it is being translated by several foreign countries. Lowell Watts, farm editor for radio station KLZ, Denver, Colo., considered the publication important enough to interview Mr. Maletic who, during the broadcast, explained the uses of the book and pointed out how proper use of weed-killing chemicals has helped farmers increase their farm income and how the Bureau has reduced operation and maintenance costs through more efficient weed control methods.

Let us get back to our problem regarding price tags on 2,4-D. Before Mr. Maletic prepared his handbook, you would have had to work out complicated mathematical formulas to arrive at the answer. With the aid of the nomogram on this page, reproduced from the handbook, you can find out in a few moments which of the commercial products of a given type will do your job at the lowest price. There are 13 of these nomograms in "Weed Control Calculations," preceded by information on how each formula was worked out and giving examples of applying the formulas to practical problems. Future issues of the Era will contain further information on how to use these nomograms. THE END.

OUR SOUTH AMERICAN NEIGHBOR has a way of irrigating tobacco by the spray method at Hacienda San Pablo, Tumero, Estada Avagua, Venezuela. Inset, Dr. Luis J. Medina, to whom we are indebted for this photo.

TWO-WAY STREET

Venezuela, the "Little Venice" of South America, was written up in the pages of the December 1949 issue of the Reclamation Era by John L. Mutz, area engineer of Albuquerque, N. Mex., of the Bureau's Region 5. Mr. Mutz is one of several engineers and irrigation experts from North America who have given technical assistance to our neighbors south of the equator. Here is evidence that Inter-American cooperation is a two-way street, and much can be learned from Latin America—a translation from a bulletin written by Dr. Luis J. Medina of Venezuela's department of agriculture:

INTRODUCTION

Irrigation, considered as a supplement to the natural precipitation for the production of food or fibers, regardless of the place where it has been established, is fundamentally an activity of an agricultural type.

The construction of a dam, a reservoir, or a canal for irrigation has as its main objective the establishment of economically sufficient farms where they did not exist before, or to transform, by means of water which Nature does not provide, farms or cattle ranches into self-sufficient production units. Without weighing down the scale on either side it can be stated that the construction of a dam, for example, is an essential, but not the most important factor for the success of the enterprise. The main objective is the improvement of the land and the best use of water for the welfare of those who during many generations will use those resources for agricultural purposes.

The farms established or benefited by means of the construction and development of irrigation projects should not be considered simply as a guarantee for the payment of the cost of the engineering works, but on the contrary, as the basis for the development of stable agricultural enterprises and prosperous and progressive rural communities.

In all lands under irrigation the principal purpose is none other than that of obtaining the greatest efficiency in the use of water, which is transformed into high production during the maximum possible number of years without causing any damage or deterioration to the lands. This requires the adoption of rational methods for the preparation of the soil, the application and use of water, etc.

In the present publication, an effort has been made to include a group of general rules on irrigation, the knowledge of which is considered useful to persons engaged in this activity, in the hope that it will contribute in some way to the improvement of present practices.

The Bureau of Reclamation's chief of irrigation operations, M. R. Lewis, who has spent considerable time in South America, obtained Dr. Medina's permission to use this translation and to translate and reprint any other excerpts from the bulletin which would be of interest to our readers. The title of the bulletin is, "Normas Generales sobre Riego con Especial Referencia a Maiz, Arroz y Hortalizas", which, in general, means, "General Procedures About Irrigation With Special References to Corn, Rice, and Truck or Garden Vegetables." The End

W. G. SLOAN

Continued from page 71)

as "living monuments to the services Glenn Sloan has rendered South Dakota and the Missouri River Basin."

In explaining his plans for the future, Mr. Sloan said "I am going to sit in the sun and get a new viewpoint, start a new life * * * I am not going to forget the Missouri Basin. The plan is moving along. It will continue to move." He explained that "unity, nonpartisan unity of purpose, the will to work together for a common cause, has been one of the dominating trends in the program in which we are all interested * * *. There has been no contention in the Missouri River Basin—here we have 10 States working together. * * * We have proven that the Bureau of Reclamation and the Corps of Engineers can work together with all agencies, Federal and State, and with the people for a common purpose."

Prior to becoming head of the Interior Missouri Basin Field Committee, Mr. Sloan was the assistant director of Region 6, Bureau of Reclamation, a position he had held since November 1943. When first joining the Bureau in 1936, he was selected to head investigations of the Rio Grande and the Missouri River Basin. It was during this period that he conceived and formulated the plan for the development of the resources of the entire Missouri River Basin as one gigantic project, with the individual development considered component and integral parts of the over-all plan.

For 4 years previous to his association with the Bureau of Reclamation, Mr. Sloan was a special engineer for the Twin Falls Canal Co. of Twin Falls, Idaho, being engaged on the design and construction of a spillway for Milner Dam and other reclamation engineering problems.

From the time of his release from the Army as a first lieutenant until 1932, Mr. Sloan maintained a private engineering practice at Boise, Idaho. For 6 years before entering the Army Corps of Engineers, Mr. Sloan was in charge of drainage and investigations for the Department of Agriculture in Idaho and adjoining portions of Oregon, Wyoming, Montana, and Utah.

Born in Paris, Ill., on August 2, 1888, Mr. Sloan is a graduate of Helena, Mont., high school and Montana State College. He is married and has one son, a California newspaperman. THE END.

BEAMING OVER BENEFITS seems to be the theme of this photo of the directors of the Orland Unit Water Users' Association as they reviewed the final work in a $250,000 rehabilitation program. (See "Orland's New Look" in December 1950 issue of the Era.) The association represents the water users in their relations with the Government. Seated, from left to right, George Naugle, Leonard W. Golinick (president) and Mrs. Berrie Kiley (secretary). Standing, from left to right, Stephen R. Angus, Jesse Monroe (vice president), Frank Lourenco, Jasper Litchsteiner and Frank I. Nichols.

Fourth Sale of Full-Time Columbia Basin Farms

April 13, 1951, is the deadline for submitting applications for the purchase of 20 Government-owned farm units on the Columbia Basin project, 120 miles southwest of Spokane in eastern Washington. Veterans of World War II will have preference in buying these units, which are in the Quincy Irrigation District, which, along with more than 600 privately owned full-time farm units, will receive water in 1952 under the project plan for full-scale irrigation operations.

The units, which are obtainable only by purchase, and not subject to acquisition through entry and settlement under Federal homesteading procedure, range in size from 30 to 143 irrigable acres. All of the farm units are unimproved except one; the prices of the unimproved units range from $410 to $1,867, while the improved unit, containing 100 irrigable acres, is appraised at $6,485.

Copies of the announcement and application blanks may be obtained from the Bureau of Reclamation at Ephrata, Wash., or from the Bureau of Reclamation, Box 937, Boise, Idaho. A public drawing will be held to establish the order in which applications will be examined and in which applicants who are found qualified may purchase the full-time farm units. ●

Tapping Lost River

(Continued from page 67)

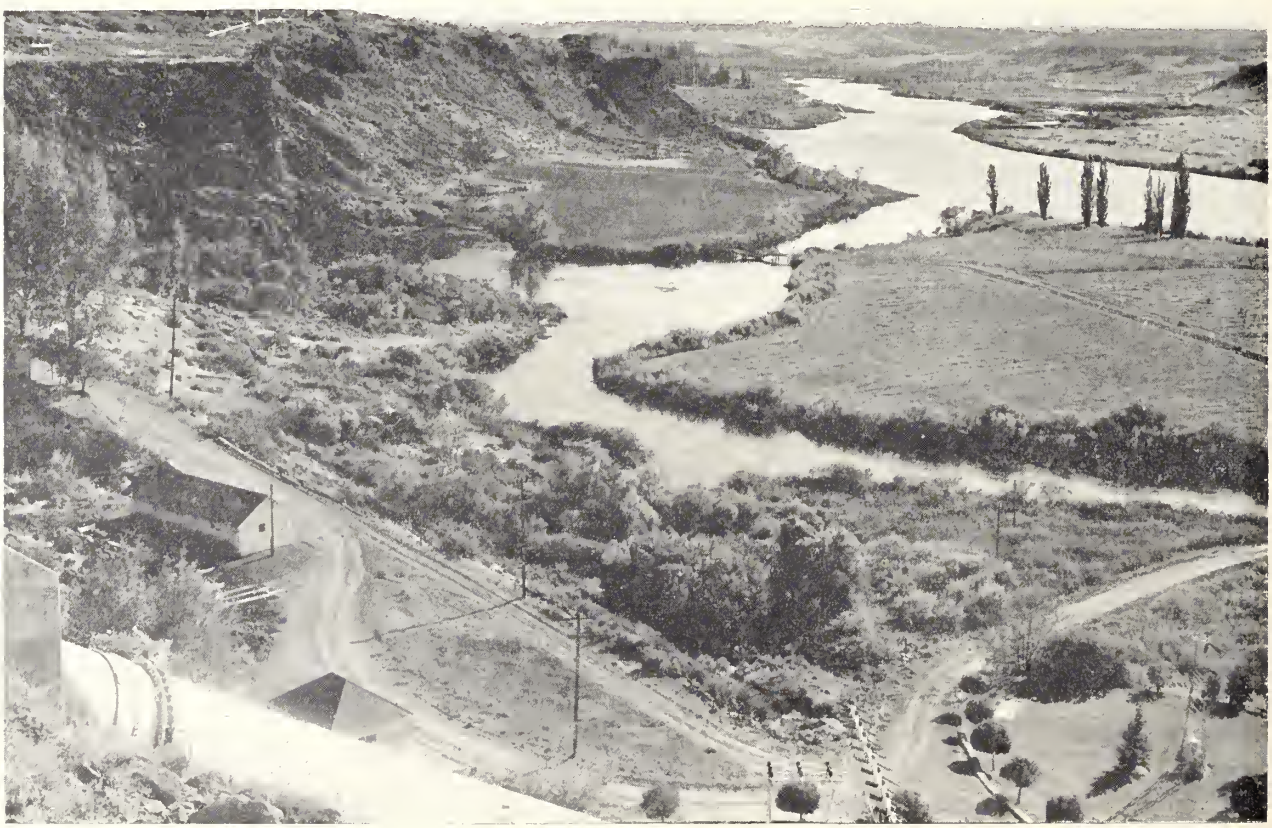
propose to open up the entire area to homesteading at once. Instead it will sink 10 more wells during the next fiscal year and about 20 every year thereafter until the required total number is reached. Block by block, the new land will be made available to World War II veterans, the first public drawing to be held in 3 or 4 years. It is anticipated that about 15 years may be required fully to develop the North Side Pumping Division.

During the testing period to determine the adequacy of the water supply, land around the wells is being leased, on a competitive basis, to farmers at an average of $10 per acre per year for 4 years. Excellent yields of beans, clover seed, sugar beets and forage crops have been realized from the newly cultivated areas.

In addition to the 64,000 acres that would be served from the underground water, the Bureau has also been authorized by the Congress to use water from the existing American Falls Reservoir and the proposed reauthorized Palisades Reservoir to serve 13,650 acres on the project through the usual surface irrigation methods.

The use of the underground supply for irrigation of what may eventually total 100,000 acres probably will have little effect on either the beauty or the volume of the Thousand Springs. The Geological Survey explains that the Federal project and private developments will use between 1,300 and 1,500 cubic feet per second during the peak of the irrigation season, as compared with the spring flow of 5,000 cubic feet per second. Normally about 50 percent of an irrigation supply seeps back into the ground; thus the net draft on the underground flow in this instance would amount to only 650 second feet. Irrigation pumping from these wells would occur only during the growing season, about one-third of the year, the annual loss amounting to an average withdrawal of only 217 second feet, or about 3 to 4 percent of the total spring outflow. Whether the effect at Thousand Springs will be felt during the summer season or at some later date is not known, but will be determined with the aid of observation wells and gaging stations now in operation. THE END.

POWER PLANT driven by some of the Thousand Springs. The outflow, totaling about half the flow of the Snake at this point, is shown in the stream in the foreground—once lost and idle, now found and productive. ***Photo by Phil Merritt, Region 1.***



Riverton Project Lands Transferred to Water Users

Secretary of the Interior Oscar L. Chapman announced the transfer of the irrigation works serving 48,000 acres of land on the Riverton, Wyo., project to the Midvale Irrigation District for operation and maintenance on January 1, 1951.

The transfer provides that the Midvale District shall be responsible for the care, operation and maintenance of Bull Lake and Pilot Butte Reservoirs along with Wind River Diversion Dam, part of the Wyoming canal and pertinent laterals serving the lands included in the first and second divisions of the project.

The Bureau of Reclamation will continue to operate the Pilot Butte power plant and the third division of the project part of which has been placed under irrigation and is being readied for GI homesteaders.

Acting Commissioner of Reclamation, Goodrich W. Lineweaver, speaking of the transfer, said "It is the continuing policy of Reclamation to encourage water users to take over and operate their own irrigation distribution systems as soon as they are in a position to assume this responsibility." To date 48 out of 65 completed projects or divisions of projects are operated by water users.

The Midvale District will acquire the necessary equipment to carry on the operation and maintenance of the project and Karl Bowers, the Bureau's administrative officer on the project, will be loaned to the District to serve as manager.

The project was authorized in 1918, construction started in 1920, and irrigation water was first available in 1925. Ultimate development calls for the irrigation of 95,000 acres. Before World War II approximately 42,000 acres were irrigated. •

Contract Awarded for Folsom Generators

The Bureau of Reclamation recently awarded a contract to Westinghouse Electric Corp. of Pittsburgh, Pa., for the fabrication and installation of three generators in the Folsom power plant on the American River near Folsom, Calif.

This plant is a feature of Folsom dam being built by the Corps of Engineers, and is an integral feature of the multipurpose water resource development of California's Central Valley. The Bureau of Reclamation is responsible for the power development at Folsom Dam which requires three generators each of 54,000 kilowatt capacity. Under normal conditions, these units could generate almost 400,000,000 kilowatt-hours of energy annually for irrigation pumping, municipal, domestic, and industrial use in this power deprived area.

The first unit is scheduled for installation in 2 years and 340 days; the second in 3 years and 165 days; the third in 3 years and 155 days. The first unit is scheduled to go on the line by June 1954 and the other two before the end of that year.

IRRIGATION DISTRICTS in the Pacific Northwest seem to have a good idea here. These new posters, prepared by a photographic process, are to be displayed in irrigation district offices in Washington, Oregon, and Idaho. The girl is Darlene Moran of Boise, Idaho. Other irrigation districts and water users associations are welcome to the idea, and the Bureau of Reclamation hereby congratulates the Pacific Northwest for this support of the reclamation farmer's own publication.

Jacob E. Warnock Honored Posthumously

The Department of the Interior gold medal for distinguished service has been awarded posthumously to Jacob E. Warnock, former head of Reclamation's Hydraulic Laboratory in Denver, Colo., Secretary of the Interior Oscal L. Chapman announced on January 24.

Mr. Warnock died in Denver on December 26, 1949, after an emergency operation. (See Reclamation Era—February 1950, p. 43.)

Secretary Chapman said "many features of multiple-purpose water resource conservation structures in the 17 western States bear the stamp of Mr. Warnock's achievements in the field of hydraulic engineering." •

WATER REPORT

On March 1, snow on the mountains and water in the reservoirs guaranteed plenty of irrigation water for Bureau projects in the Colorado River Basin, most of the Missouri Basin and in the Sacramento-San Joaquin district. Heavy rains and melting snows caused some rivers to run bank-full in the northwest. In the Great Basin, the main stem of the Colorado River and the Pecos Basin, the signs pointed to an adequate supply, although Rio Grande and Salt River Basin projects had no reason to hope for relief from the continuing drought. As a matter of fact, in Arizona, New Mexico, and Texas, a severe water shortage is developing as the flow into reservoirs decreases. Flow into Roosevelt Reservoir of the Salt River project hit a record low for the sixth consecutive month.

By regions (see map on back cover to locate areas) the situation is as follows:

REGION 1.—Early forecast indicates that all projects should have enough water to meet the next season's irrigation needs. In the Malheur drainage area serving the Vale project in eastern Oregon, although the water content of the snow is not as it has been in the past, and the reservoir storage continues below normal, the farmers should have enough water to irrigate next season's crops. The Okanogan project in northern Washington received only half the amount of snow or rain for this time of year. In addition, this project experienced unusually warm February weather which melted the snow rapidly, thus cutting down the possibility of heavy spring floods. On the Yakima project, in southern Washington, however, it was colder than usual and the snow and rain was about 180 percent of normal. It is a little early to predict spring weather conditions, but if the snow continues to accumulate as it has, and if cold weather prevails until the return of spring, the northwest floods may again cause damage in vulnerable areas.

REGION 2.—All the reservoirs which already were full enough for this time of year received more than the usual amount of water during February. The flow of the Sacramento River into Shasta Lake amounted to 179 percent of normal and the San Joaquin River into Millerton Lake amounted to 210 percent or normal for this year.

REGION 3.—Snow cover on the head waters of the Colorado River in Wyoming and Colorado which eventually will melt and flow into Lake Mead was generally above average for March 1 and considerably above last year. However, Lake Mead can hope for little snow melt from the drainage areas in New Mexico as snow has accumulated at a disappointingly slow rate and no snow remains in the lower elevations. Even though the flow into Lake Mead was only 90 percent of normal, the large hold-over storage gave ample assurance that the projects using Lake Mead water will have abundant water to irrigate their crops. By February 15 only a few snowdrifts remained on the Verde River watershed and there was practically no snow remaining on the Salt River drainage area below 8,500 feet.

Beneath the snow, wherever it could be found, was dry soil which will probably absorb most of the snow melt leaving very little water for the reservoirs of the Salt River project which now are critically low.

REGION 4.—In this, the intermountain region, many of the projects carry over very little stored water because their reservoirs are small, their capacity being only large enough for yearly irrigation needs. These projects rely on each year's snowfall for water to irrigate their crops during the coming year. While not seriously low, the snowfall this year has been below normal on the Mancos Fruit Growers Dam, and Pine River project in Colorado. For the rest of the region, there seems to be enough snow cover to supply the reservoirs with ample water for this summer's irrigation needs.

REGION 5.—Except for the Rio Grande project in Texas and New Mexico the reservoirs are storing as much water as usual for this time of year. On the W. C. Austin project in Oklahoma, due to more than 4 months of drought, water was delivered during February to pre-irrigate potato land, and to irrigate alfalfa and winter wheat. In spite of this release of stored water, the Altus reservoir was about one-third of a foot above the uncontrolled spillway. Due to extremely low run-off into Elephant Butte no stored water is being released to the Rio Grande project and soil moisture conditions are reported as poor. Private wells are being dug and pumps are being installed to pump drain water to supplement surface water. Under these circumstances the water users have agreed to ration the project stored water at the rate of 1 acre-foot per acre during the next irrigation season—until and unless storage increases.

REGION 6 and REGION 7.—There seems to be sufficient water in prospect for next year's crops. On the Belle Fourche project in South Dakota the field reports the outlook for the reservoir as poor instead of the previous report of fair. Flow into the reservoir was below normal during the month and very little runoff can be expected from the snow and the drainage area above the reservoir. ●

CROPS

Castor Beans on the W. C. Austin Project

Castor beans were raised on the W. C. Austin project in Oklahoma, for the first time in 1950. A commercial castor bean company contracted with the farmers to buy their entire production, and guaranteed to pay 6 cents a pound or the New York market price, whichever was greater. For the month of September the price paid farmers was 9.4 cents a pound, dropped to 9 cents a pound on October 1, and had held steady at that price since. There has been no distinction made in the price of beans for the oil mill and the price of those saved for seed.

There were approximately 950 acres raised in the irrigation district in 1950 and some 500 acres in nonirrigated areas in this vicinity. Castor beans were also raised in Oklahoma, near Frederick, Sayre, Eldorado, Mangum, and McAlester, and at Quanah and Vernon, Tex.

The crop was planted on all types of soil, ranging from deep sand through loam to tight clay, but seemed to do best under irrigation in loamy soil. The fields should have good surface drainage. A few fields planted on level borders were drowned out during the rainy weather.

Methods of seed-bed preparation, planting and cultivation are very similar to those used in raising cotton. Farmers who are producing cotton are therefore equipped to raise castor beans. The beans do not need as much cultivation as cotton, nor is it necessary to thin the stand by chopping. So far there has been no insect damage.

Very little irrigation was used on the crop during 1950 because of the unusually wet summer. It is thought that about the same amount of water is needed as in the production of cotton, and that in a dry year frequent irrigations will be necessary.

The beans grow inside pods or burrs. The burrs are fastened to the plants in clusters called spikes. The plants start putting on spikes early, and continue forming spikes at the top as the plants grow, until frost occurs. On the best varieties at present, the beans in the bottom spikes will shatter out before the top spikes are mature. Early harvesting of the bottom three to five

HULLING and LOADING—In upper left photo castor beans are being hulled and clean beans loaded for shipment at oil mill in California's "DWARF" variety of bean, at left. **HARVESTING** castor beans after frost on W. C. Austin project, Oklahoma, above. *Photo above by P. W. George, Region 5, others through the courtesy of the Baker Castor Oil Company.*

spikes on each plant must be done by hand. The burrs are stripped by hand from the spikes and placed in sacks, much like cotton is harvested. The later crop can be harvested either by hand or by mechanical castor bean strippers.

Local processing of the beans is simple, and consists of running the burrs through a huller to separate the beans from the burrs. The huller is owned by the commercial castor bean company, which also has hullers at McAlester, Okla., and Vernon, Tex.

Marketing is simple. The beans are weighed and the farmers are paid at the time of hulling. The hulled beans are loaded in boxcars by the company and shipped to oil mills in New Jersey and California for final processing.

The yield last year under irrigation averaged approximately 1,000 pounds of clean beans per acre, an average gross income of $90 per acre at the present price. Some farmers harvested as high as 2,000 pounds per acre making about $180 an acre. On nonirrigated land the yield was from 500 to 750 pounds per acre. There are different varieties for irrigated and nonirrigated land. U S 74 was the variety used on irrigated land and Conner was used on nonirrigated land. Most farmers say that castor beans will make them more money than grain, sorghum, or wheat. (See "Castor Beans for Peace or War," p. 45, March 1951 Reclamation Era.) ●

LETTERS

Many Happy Returns

Please discontinue my subscription, with many thanks for the years I enjoyed the Era. I passed my eighty-seventh birthday, and do not read as much as I did many years ago. I think the Era has done wonderful work for the U. S. A.

Fred Remender,
Morrill, Nebr.

Somehow we don't mind receiving a discontinuance notice like this.—Editor.

Try and Beat This!

Yakima, Wash.
January 18, 1951.

Gentlemen: In the January issue of the Era I have noted a letter from Miss Anna J. Larson of Burley, Idaho. The editorial comment states that Miss Larson has been a subscriber for 34 years, and you ask "Is this a record?"

I was a land holder in the Yakima Tieton project at the time the Tieton Canal was constructed. I was the first Secretary of the Tieton Water Users' Association. I have been a subscriber to the Reclamation Era, formerly the Record, since the magazine was first mailed to the land owners in this project. I am not certain as to the exact year, but think it was 1910. If I am correct this beats Miss Larson's record by 6 years.

Yours truly

(Sgd.) C. H. Hinman,
606 Hinman Drive,
Yakima, Wash.

P. S. I might imitate Miss Larson by paying my subscription to the Era 10 years in advance but as I was 80 years old the seventh of this month, I am afraid I will not be sticking around that long. C. H. H.

Beet Pulp Fattens Steers

Bloat in fattening steers can be eliminated by including dry sugar beet pulp in the ration, according to Leo Sinner, who has had 10 years of experience with this feed on his farm in Cass County, N. Dak.

"Ever since I began using pulp," Sinner stated, "I have had no sickness traceable to bloat in my cattle. Beet pulp, pound for pound, has the same feeding value as corn. So, I consider it one of my best feeds when it is no higher in price than corn. However to avoid getting too much bulk I never use it in excess of 20 percent of the total ration.

"Beet pulp is deficient in phosphorus. To compensate for this, I include one-tenth of a pound of bonemeal per steer daily when I am using pulp."—(Reprinted from the October 1950 issue of The Northwest, monthly publication of the Northern Pacific Railroad.)

NOTES FOR CONTRACTORS

Contracts Awarded During February 1951

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DS-3251	Colorado-Big Thompson, Colo.	Feb. 23	One 48,000-hp. hydraulic turbine with pressure regulator and energy absorber for Flatiron power plant.	Pelton Water Wheel Co., San Francisco, Calif.	$274,055
DS-3256	Missouri River Basin, Mont.	Feb. 5	Structural steel for spillway bridge at Canyon Ferry Dam	Virginia Bridge Co., Denver, Colo.	59,878
DS-3259	Missouri River Basin, Nebr.	Feb. 7	140,000 tons of crushed rock or gravel blanket material and 300,000 tons of riprap rock for Trenton Dam, schedules 1 and 2.	Cass Co., Contractors, Ogallala, Nebr.	443,000
DS-3260	Missouri River Basin, S. Dak-Wyo.	Feb. 6	Structural steel for State highway bridge, relocation of State highway (U S 14), Keyhole Dam.	Burkhardt Steel Co., Denver, Colo.	20,206
DS-3261	Colorado-Big Thompson, Colo.	Feb. 6	One 96-inch butterfly valve with operating mechanism and control system, 2 conduit sections and accessories, and 1 portal sleeve for Carter Lake pressure tunnel, Estes Park-Foothills power aqueduct.	Pelton Water Wheel Co., San Francisco, Calif.	56,600
DS-3265	do	Feb. 7	Three governors with pumping equipment for regulating speed of turbines at Pole Hill and Flatiron power plants.	Woodward Governor Co., Rockford, Ill.	82,430
DC-3268	Fort Peck	Feb. 5	Construction of 92 miles of Glendive-Williston 115-kv. transmission line.	J and J Construction Co., Oklahoma City, Okla.	851,623
DC-3269	Missouri River Basin, Colo.-Nebr.	Feb. 12	Construction of 7 miles of Julesburg tap-Julesburg 115-kv. transmission line.	R. N. Campsey Construction Co., Denver, Colo.	70,546
DS-3274	Hungry Horse, Mont	Feb. 14	Hollow-metal doors for Hungry Horse Dam and power plant, item 1.	M. Reuter and Sons, Portland, Oreg.	29,771
DS-3275	Missouri River Basin, Nebr.	Feb. 6	One lot of fabricated steel pipe and accessories, control well, and pipe and fittings for Trenton Dam, item 1.	Eaton Metal Products Co., Denver, Colo.	14,764
DS-3276	Columbia Basin Wash	Feb. 28	Six 30-inch welded-plate-steel pump discharge pipes, 3 sections of 54-inch pipe, make up pieces and accessories for Quincy pumping plant.	American Pipe & Construction Co., Portland, Oreg.	22,627
DC-3304	Riverton, Wyo	Feb. 21	Construction of buried asphaltic membrane lining for Wyoming Canal, station 1741+00 to 1970+25, schedule 1.	Studer Construction Co., Billings, Mont.	103,795
DC-3304	do	do	Construction of buried asphaltic membrane lining for Wyoming Canal, station 1980+50 to 2275+00 and 2325+50 to 2560+00; laterals W44.13 and W44.69, schedules 2 and 3.	Lichty Construction Co. and Brasel & Whitehead, Riverton, Wyo.	115,065
DC-3304	do	do	Furnishing and applying riprap for Wyoming Canal, station 2325+00 to 2560+00, schedule 4.	Gilpatrick Construction Co., Riverton, Wyo.	24,750
117C-90	Columbia Basin, Wash	Feb. 1	Completion and paving of 4-lane highway, left switchyard access road, and paving of North Dam crest roadway.	Goodfellow Bros., Inc., Wenatchee, Wash.	292,775
117C-87	do	Feb. 16	Construction of watermaster office building, storehouse, garages, and general purpose shop at O & M Headquarters, Winchester, Moses Lake, Mesa and Warden, Wash., schedules 2, 3, 4.	Don Williams & Co., Seattle, Wash.	229,389
100C-114	Deschutes, Oreg	Feb. 21	Pneumatically applied mortar canal sealing, mile 7 to mile 26, North Unit, Main Canal.	Concrete Elevating & Shotcrete Co., Seattle, Wash.	18,428
117C-91	Columbia Basin, Wash	Feb. 16	Construction of residences, garages, watermaster office building, utility building, and facilities at O & M Headquarters, Adco, Wash.	Commercial Builders, Inc., Moscow, Idaho.	162,655
200C-140	Central Valley, Calif	Feb. 13	Radio hutments for Mount Oso, Grapevine Pass, Bear Mountain, and Bass Mountain relay stations.	R. E. Ziebarth, Torrance, Calif	49,917
300C-8	Davis Dam, Ariz.-Nev	Feb. 16	Construction of machine and apparatus repair shops at system O & M area.	Daum-Donaldson Construction Co., Phoenix, Ariz.	225,794
300C-9	do	Feb. 20	Construction of Maricopa substation	George E. Miller, Longbeach, Calif.	32,768
600C-53	Riverton, Wyo		Drilling water-supply wells and moving and erecting residences for ditchriders' camps Nos. 9 and 10, and Development Farm, schedules 4, 5, and 6.	Charles M. Smith, Thermopolis, Wyo.	36,177
604C-20	Missouri River Basin, Mont	Feb. 8	Clearing part of Canyon Ferry Reservoir	C. L. Hubner, Denver, Colo	46,500
710C-165	Missouri River Basin, Nebr.	Feb. 7	Medicine Creek Reservoir development	Northwest Realty Co., Alliance, Nebr.	17,287
7035-167	Missouri River Basin, Wyo.	Feb. 27	One 1,000-kilovolt-ampere step-voltage regulator for Chadron substation, item 1.	Maloney Electric Co., St. Louis, Mo.	27,416

Construction and Materials for Which Bids Will Be Requested by June 1951

Project	Description of work or material
Cachuma, Calif.	Construction of 102-foot-high, 290,000-cubic-yard earthfill Glen Anne Dam on the west fork of Glen Anne Creek, northwest of Goleta, Calif.
Do.	Four 50-foot by 30-foot radial gates with counterweights for Cachuma Dam.
Do.	Two 30-inch hollow jet valves for Cachuma Dam.
Central Valley, Calif	Construction of about 42 miles of concrete and reinforced concrete irrigation pipelines, 12 to 54 inches in diameter, for Ivanhoe irrigation district, Friant-Kern Canal distribution system.
Do.	Construction of 25 miles of concrete and reinforced concrete irrigation pipelines, 12 to 36 inches in diameter, for the Stone-Corral irrigation district, Friant-Kern Canal distribution system, near Seville, Calif.
Do.	Construction of 20 miles of concrete and reinforced concrete pipelines, 12 to 33 inches in diameter, for unit 1, Exeter irrigation district, Friant-Kern Canal distribution system, near Exeter, Calif.
Do.	Excavation of about 3 miles of tailrace channel on American River, and excavation for penstocks and foundation of Folsom power plant and warehouse area near Folsom, Calif.
Do.	Construction of 118 miles of 230-kv. Bonneville Power Administration tie transmission line from Shasta switchyard to Klamath Falls substation.
Do.	Construction of a 40- by 140-foot office building, a 40- by 60-foot laboratory and warehouse building, and a 10-car garage at Folsom power plant.
Central Valley, Calif	5 vertical-shaft turbine-type pumping units with capacities of 7 c. f. s., 3.5 c. f. s., 3 c. f. s., and two 180 g. p. m. for Exeter irrigation district pumping plants E1 and E2.
Do.	9 pump manifolds for pumping plants, southern San Joaquin municipal utility district.
Do.	Main control board extension for four 115-kv. and two 69-kv. circuits and 2 transfer breaker panels for Tracy switchyard.
Do.	Motor control switchgear, distribution switchboards, and float switches for southern San Joaquin municipal utility district No. 3.
Do.	6 vertical-shaft, propeller-type pumping units, each of 33.3 c. f. s. capacity, for pumping plant No. 1; 2 horizontal centrifugal-type pumping units, each of 15 c. f. s. capacity, for pumping plant No. 2, Columbia Canal; and 2 vertical-shaft, propeller-type pumping units, each of 5 c. f. s. capacity, for pumping plant on Mowry Canal, Delta-Mendota Canal distribution system.
Colorado-Big Thompson, Colo.	Construction of Rattlesnake Dam, a 105-foot high, off-stream, 150,000 cubic yard earthfill structure, which will have 250,000 cubic yards of rock fill on upstream and downstream slopes, and a 10,400 c. f. s. capacity spillway, 14 miles west of Loveland, Colo.
Do.	Furnishing and laying Pole Hill and Flatiron power plant penstocks and Carter Lake pressure conduit.

Project	Description of work or material
Colorado-Big Thompson, Colo.	Construction of 2,100-foot concrete-lined Pole Hill Canal and 500 feet of concrete bench flume to carry a capacity of 550 c. f. s. from outlet of Pole Hill Tunnel to penstock inlet at Pole Hill power plant.
Do	One 460-v. and one 125-v. distribution board, two 125-v. battery chargers, two 500-kv.-a. transformers, and one 37½-kv.-a. lighting transformer for Pole Hill power plant.
Do	Generator voltage bus and circuit breaker, including generator protective equipment, for Pole Hill power plant.
Do	Main control board, 115-kv. and 69-kv. circuits, for Beaver Creek substation.
Do	Furnishing and installing steel penstocks for Pole Hill and Flatiron power plants.
Do	Main control boards, distribution boards, battery charging equipment, heating control boards, lighting distribution panel, and station service transformers for Flatiron power and pumping plant and Pole Hill power plant.
Do	Two 6-foot 9-inch by 9-foot top seal radial gates with hoists for Flatiron afterbay dam.
Do	Station-service unit substation and distribution boards for Willow Creek pumping plant.
Do	Motor control switchgear for Willow Creek pumping plant.
Columbia Basin, Wash	Construction of 5.5 miles of 2,000 c. f. s. capacity unlined West Canal; Frenchman Hills wasteway and turnout structure; and 3 miles of county road relocation, 20 miles south of Quincy, Wash.
Do	Construction of 17 miles of laterals, 36 miles of sublaterals, 14 miles of drain wasteways, and placing buried asphalt membrane lining for lateral area W-6A on West Canal, south and east of Quincy and Winchester, Wash.
Do	Two 12- by 15-foot radial gates and two 10,000-pound radial-gate hoists for Lind Coulee wasteway; and two 17- by 15-foot radial gates and two 15,000-pound radial-gate hoists for East Low Canal.
Do	Construction of building for housing radio receiving and transmitting equipment at Ephrata, Wash.; and radio equipment buildings at Quincy and Othello, Wash.
Do	Grading and surfacing about 8,000 square yards of driveways and parking areas at Ephrata field office site.
Do	Construction of 96- by 57-foot concrete block major shop building at Quincy, Wash.
Do	10 horizontal centrifugal-type pumping units of 17 to 30 c. f. s. capacities for Babcock pumping plant, lateral W-8 area.
Davis Dam, Ariz.-Nev	Erection of steel structures and installation of additional electrical equipment for Tucson substation.
Do	Construction of paint shop, washing and greasing rack, vehicle repair shop, service station, storage sheds, and fencing at Phoenix, Ariz., and Parker Dam, Calif.
Davis Dam, Ariz.-Nev	One 20,000/25,000-kv.-a. autotransformer, one 115-kv. step-voltage regulator, two 115-kv. circuit breakers, 1 station-service transformer, nine 115-kv. disconnecting switches, and three 115-kv. and three 230-kv. lightning arresters for Prescott substation.
Do	Main control board for 230-kv., 115-kv., and 13.8-kv. circuits for Prescott substation.
Fort Peck, Mont	Approximately 35,000 pounds of fabricated galvanized structural steel and pipe for new Glendive substation.
Missouri River Basin, Mont.	Clearing remaining area of Canyon Ferry Reservoir, east of Helena, Mont.
Do	1 main control board, 1 annunciator relay cabinet, one 1,500-kv.-a. unit substation, one 46-volt distribution board, and two 5-kw. battery chargers for Canyon Ferry power plant.
Do	One 9.04- by 9.04-foot fixed wheel gate lifting frame, 1 gate engagement indicator, and 4 gate slot closures for Canyon Ferry Dam.
Missouri River Basin, Nebr.	Construction of 7,500-kv.-a. Ogallala substation.
Do	Construction of 3,333-kv.-a. Chadron substation.
Do	Construction of Franklin south side pumping plant, 5 miles of 45 to 18 c. f. s. capacity unlined Franklin south side canal, and 5 miles of 15 to 6 c. f. s. capacity laterals.
Missouri River Basin, N. Dak.	Construction of 167 miles of 230-kv. steel-tower transmission line between Bismarck, N. Dak., Mobridge, S. Dak., and Oahe damsite, S. Dak.
Do	Construction of 4 miles of Garrison (Fort Peck tie) 115-kv. transmission line connecting Williston-Garrison and Garrison-Bismarck lines.
Do	Furnishing and erecting prefabricated buildings for Bismarck, Devils Lake, and Jamestown substations.
Missouri River Basin, S. Dak.	Construction of 112 miles of Midland-Rapid City 115-kv. transmission line.
Do	Construction of 135 miles of 230-kv. steel-tower transmission line between Oahe damsite and Fort Randall power plant.
Do	Construction of 3,750-kv.-a. Gregory substation.
Do	First stage construction of 10,000-kv.-a. Woonsocket substation.
Do	19,000 tons of fabricated galvanized structural steel for bolted steel towers for Oahe-Fort Randall-Sioux City 230-kv. double-circuit transmission lines.
Paonia, Colo	Construction of headworks and enlargement of 3.3-mile Overland canal, and construction of ½-mile lateral No. 1, northwest of Hotchkiss, Colo.
Rio Grande, N. Mex	Construction of 52 miles of Belen-Willard 115-kv. transmission line.
Do	Construction of 7,500-kv.-a. Willard substation.
Shoshone, Wyo	Construction of Willwood Canal crossing of the C. J. Coulee near Cody, Wyo.

United States Department of the Interior
Oscar L. Chapman, Secretary
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Washington Office: United States Department of the Interior, Bureau of Reclamation, Washington 25, D. C.

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1951

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BUREAU OF RECLAMATION OFFICES .... Inside back cover

Ruth F. Sadler, *Editor*

Subscription rate $1 a year for persons residing in the United States and Canada; $1.50 a year for foreign subscriptions; special rate of 50 cents a year for members of water users' associations, and Bureau of Reclamation employees.

OUR FRONT COVER

Reclamation Street

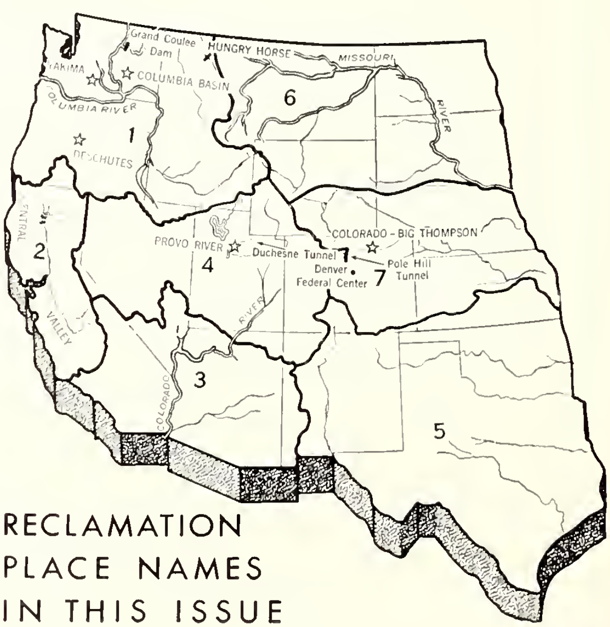
On the other side of the world, Commissioner of Reclamation Michael W. Straus happened to be strolling through the streets of Hong Kong and came across this sign—a symbol of world-wide knowledge of, and interest in, Reclamation. Read "Reclamation Street—26,000 Miles Long" o.. page 95 of this issue.

30 YEARS AGO IN THE ERA

ARBORICULTURE

Did you know that Arbor Day is western in its origin? It originated in the fertile brain of one of our most distinguished and honored citizens, the late Hon. J. Sterling Morton, of Nebraska. Before the Civil War he was the owner of a certain barren tract of ground upon which, according to popular belief, not a single tree would grow. But Mr. Morton believed he knew better. He ordered a consignment of trees from the East, planted them, and had the satisfaction of seeing them thrive. He straightway named his home Arbor Lodge, and later, as a member of the Nebraska Legislature, introduced a bill and persuaded that body to set aside a day in April for the planting of trees and shrubs by the citizens.

(From page 212 of the May 1921 issue of the RECLAMATION RECORD, predecessor to the RECLAMATION ERA.)



RECLAMATION PLACE NAMES IN THIS ISSUE

Salt River Valley Water Users' President Becomes Under Secretary of the Interior

Richard D. Searles, president of the Salt River Valley Water Users' Association, active member of the National Reclamation Association, and prominent Arizona reclamationist, was nominated Under Secretary of the Interior on April 2, 1951, by President of the United States Harry S. Truman. The Senate unanimously confirmed the appointment on April 17.

Mr. Searles is a native of Cedar Rapids, Iowa, and a graduate of Northwestern University School of Commerce. After completing his studies, he spent 15 years with the Fidelity & Deposit Co. of Maryland, and later operated his own company in Chicago, Ill. He moved to Arizona in 1940 where he purchased a ranch near Scottsdale, located on the Salt River project.

This is the Bureau of Reclamation's oldest irrigation and power project, well known as the pilot of all subsequent reclamation developments. Among its principal features are the Roosevelt Dam (named in honor of the late President Theodore Roosevelt, during whose administration the Reclamation Act was passed), the Horse Mesa, Mormon Flat, Stewart Mountain, Horseshoe, and Bartlett Dams.

Mr. Searles immediately took an active interest in the project upon his arrival in Arizona and was responsible for promoting the advancement and improving the operation and maintenance of its power and irrigation facilities including the Reclamation dams plus power plants built by the Salt River Valley Water Users' Association to meet the ever-increasing demands for electric power. He became president of the association in 1948.

Interior's New Under Secretary, Richard D. Searles.
Photo by Abbie Rowe—Courtesy National Park Service.

Recently he has served in the capacity of consultant to the Secretary of the Interior. As a representative of the Salt River Valley Water Users' Association he testified before Senate Committees on the use and benefits of artificial precipitation and salt water conversion.

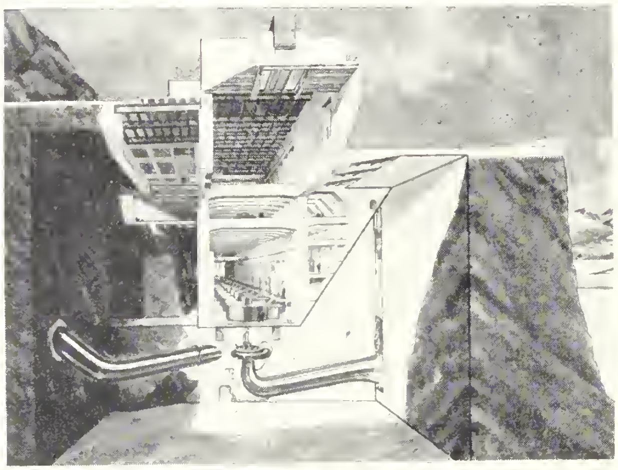
He is married and plans to make his home in Virginia.

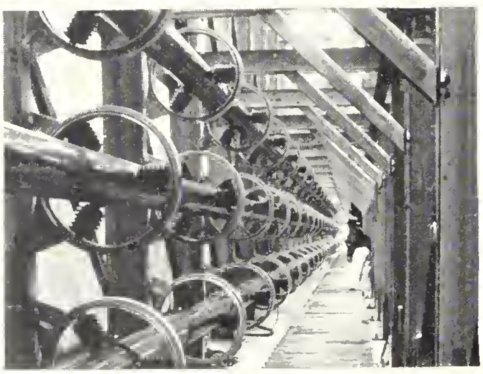
IMPORTANT NOTICE TO SUBSCRIBERS

The Office and Project Directory of the Bureau of Reclamation which was formerly printed quarterly and distributed through the facilities of the *RECLAMATION ERA* will no longer be inserted in this periodical. Quarterly issues will be prepared and distributed by the Bureau's Denver, Colo., office. This move was made in the interests of economy. However, *RECLAMATION ERA* subscribers who wish to obtain copies of the four-page directory may do so by requesting them from Chief, Supply Services Division, Bureau of Reclamation, Denver Federal Center, Denver, Colo. The next issue of the directory will be published in June 1951.

The *RECLAMATION ERA* will continue to carry a directory of the Commissioner's staff and regional directors in each issue.

HOW IT WORKS is shown in the cutaway profile drawing. Water enters the pumps from approximately 100 feet below the surface of Franklin D. Roosevelt Lake. Pumps discharge the water into pipes which lift the water 280 feet and empty it into the feeder canal. The pumping plant is almost 15 stories high, but like an iceberg, most of the structure is buried below the surface. *Drawing by the Denver office, Bureau of Reclamation.*





THE BIG LIFT

PRIMING THE PUMPS AT GRAND COULEE DAM

Around the first of this month, the Columbia River will rise above itself.

The Bureau expects a crowd to witness this historic event, but because of tightened security restrictions, the general public will not be admitted to the world's largest pumping plant which is making the feat possible. Public ceremonies may be held at the top of the hill approximately 280 feet above Franklin D. Roosevelt Lake where the first water will gush from a 12-foot pipe, at the headworks to the Feeder Canal.

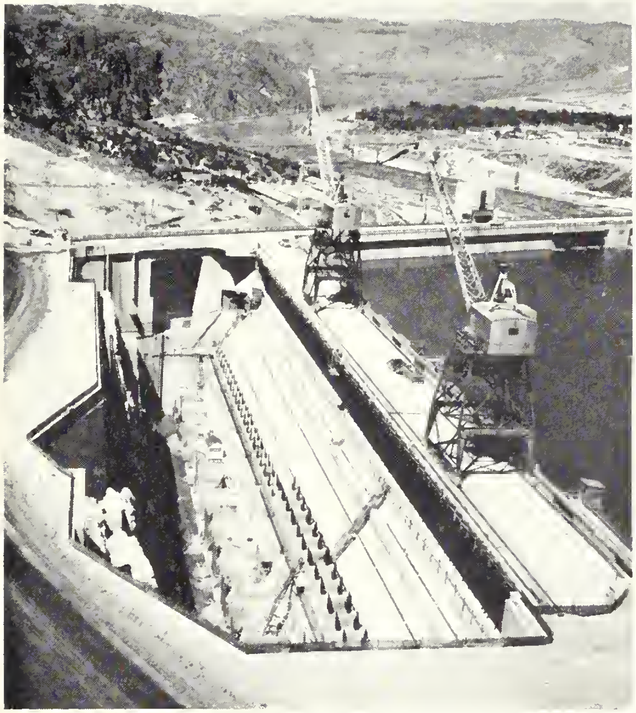
Puddling and priming the irrigation network will continue through summer and fall 1951, and will be resumed in early 1952.

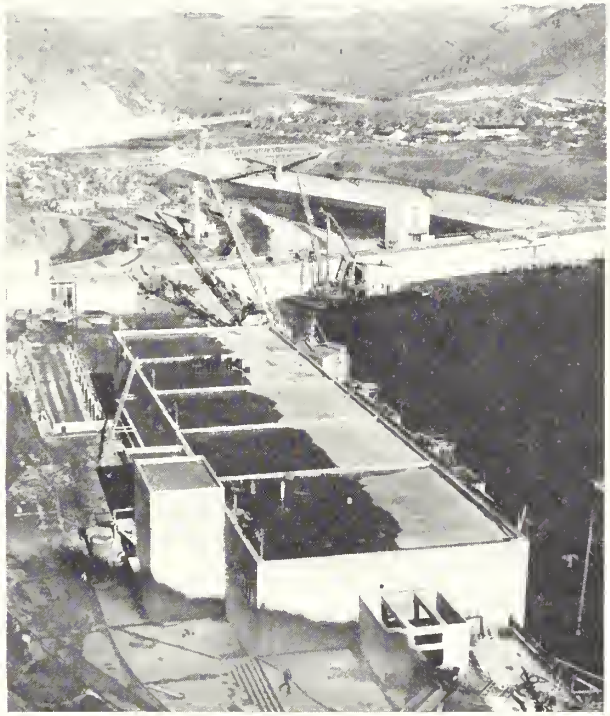
There are settlers who have waited 50 years for the good news which will be signalled by the start of the first pump—the irrigation of the Big Bend country in central Washington, starting about 60 miles south of Grand Coulee Dam. The starting of the pump means that water will be available to go onto the first 87,000 acres of land in spring 1952. Ultimately, the Bureau of Reclamation schedules the irrigation of about a million acres, a "new state" in this area, two-thirds the size of Delaware.

The pictures on these two pages show how the huge pumping plant works. Using the ice-age channel as a storage reservoir makes it possible during the early years to pump with off-peak power. This will not require power that could be used by the critical defense industries of the Pacific Northwest. By the time the pumping demands increase to such a point that one or more pumps must work steadily during the irrigation season, additional generator capacity will be in service to more than offset the power diversion.

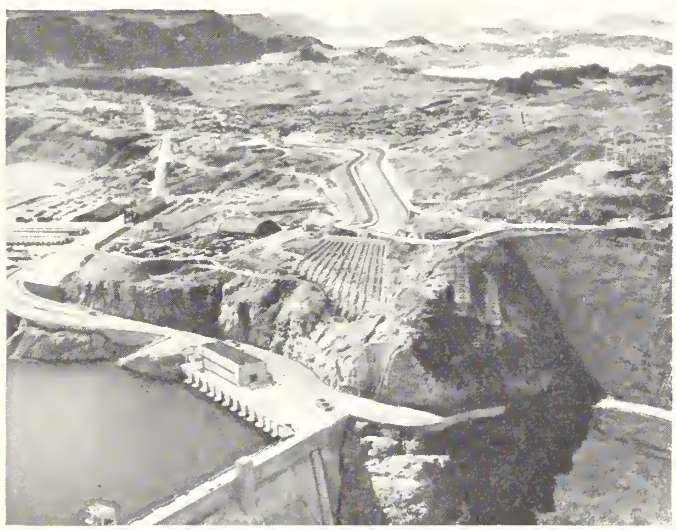
The End.

CONNECTING LINKS are shown in the center photo by H. Wayne Fuller. Falling water at the dam generates hydroelectric power. The giant bus bars carry a small part of this power up the left abutment of the dam to the pumping plant behind. By means of these bus bars, hollow copper tubes, each pair of pump motors is direct-connected to one 108,000-kilowatt generator in the left power house. The photo at immediate left, taken by F. B. Pomeroy, shows the casing through which 50 tons of water each second will pass when the pump is in operation. Ultimately there will be 12 pumps; 6 are under contract. During the early years of irrigation off-peak power will be used for pumping.





BEFORE AND AFTER—The world's largest pump is inside the 600-foot-long wing dam, adjacent to the left abutment of Grand Coulee Dam. The first view (above) was taken by F. B. Pomeroy on June 28, 1948, before the Morrison-Knudsen Co., Inc., and Peter Kiewit Sons' Co. started work on their $13,982,593 contract to complete the pumping plant. The after photo (taken by H. W. Fuller on January 17, 1951) shows the structure as it appeared when 95 percent complete.



OVER THE HILL—Columbia River water will climb through the huge pipes shown immediately above. The air photo shows what will happen when the first pump starts at Grand Coulee Dam. The first pump unit, located deep inside the pumping plant (drawn in foreground) will start turning as power feeds from the L–1 generator in the left powerhouse. Water will surge up the discharge pipe, far right on the hill, into the winding Feeder Canal (center of photo). The Columbia River ultimately will fill the Grand Coulee in the background, thereby reentering its ice-age channel, and forming an active storage reservoir for 1,202,000 acre-feet of water. Two earthfill dams, 27 miles apart, will seal the coulee as a reservoir. The first two pumps will require almost 3 months to fill the reservoir to a depth that will push water over the sill of South Dam, thence into the Main Canal which feeds the irrigation project. *Both photos by F. B. Pomeroy, Region 1 photographer; art work by Russ Ducette, also of Region 1.*

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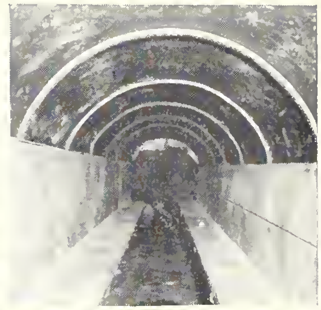
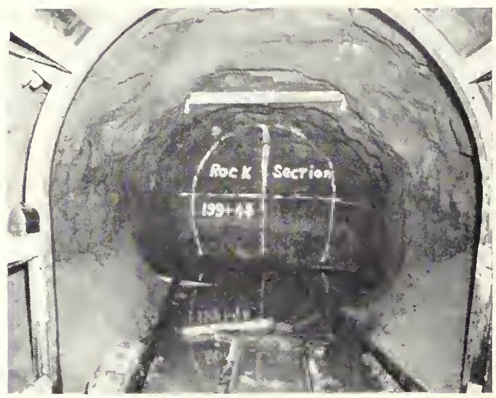


TROUBLESOME TUNNEL—Above, jumbo set-up for drilling in tight spots to install steel supports. Above right, workers' "Subway." Center right, checking the roof. Immediate right, reconditioned tunnel. Next, "Diagram for Destruction." "Diagrom" photo by W. Broadfoot, Region 4, "Subway" photo, photographer unknown, others by M. F. Edwords, Region 4.



Difficulties at Duchesne

Punching an 11-foot hole through a 6-mile section of the Wasatch Mountains east of Salt Lake City is grim business—even for the veteran tunnel experts whose amazing exploits a year ago saved the 1950 peach crop for Grand Valley, Colo.

The confident crews of Grafe-Callahan Construction Co., and Rhoades Bros. & Shafner, who came to Utah fresh from their brilliant achievement in Colorado and looking for more worlds to conquer are ready to admit that the Duchesne Tunnel is in a class by itself when it comes to tough construction.

Apparently, driving a by-pass tunnel around a landslide and through hard rock 33 days quicker than anyone dared expect was duck soup compared to piercing the Great Basin Divide. The Grand Valley record-breakers, who were awarded a $4,379,961 contract on September 15, 1949, to complete the Duchesne Tunnel, find themselves fighting to stay on schedule after nearly a year and half of toil, mostly on a 24-hour, 6-days-a-week schedule.

The reasons: the usual construction headaches plus a two-ply humdinger—massive quartzite that

explodes without powder, and drills out about five times harder than average rock.

Even with the latest equipment, progress is little better (if any) than was achieved more than 40 years ago in driving another 6-mile irrigation tunnel near Montrose, Colorado—the Gunnison Tunnel constructed by the United States Reclamation Service to divert water from the Gunnison River for the irrigation of lands in Uncompahgre Valley. But much of the Gunnison Tunnel was drilled through relatively soft sedimentary formations. If the old timers had been confronted with the adamant quartzite of Duchesne Tunnel, they might have given up.

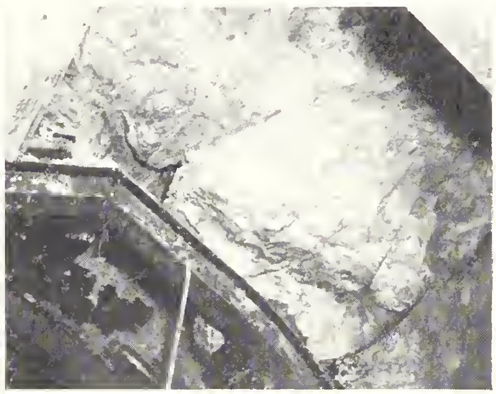
Incidentally, the Duchesne Tunnel, which is 1,020 feet longer than the 30,645-foot Gunnison Tunnel (dedicated way back in September 1909 by President Taft), will be second only to Reclamation's longest irrigation tunnel—the 13.1 mile Alva B. Adams Tunnel of the Colorado-Big Thompson project. It is interesting to note that the three longest tunnels designed primarily to carry water to grow food are located in or close to the Upper Colorado River Basin.

Now slightly more than half completed, the second longest irrigation tunnel is a straight bore designed to bring surplus flows of the Colorado River Basin from the North Fork of the Duchesne River into Deer Creek Reservoir via the Provo River. If fully lined, it can accommodate flows of up to 600 second-feet of water needed to help irrigate 46,000 acres of fertile land between Provo, Utah, and Salt Lake City.

Workers on the Duchesne Tunnel haven't been plagued by carbonic acid gas nor by so great a volume of water as the 2-second-foot flows which delayed construction of the Gunnison Tunnel, but here is what they have had, not to mention some weird moments that space doesn't permit telling about.

This is a one-way job—with the crews digging from one heading only, the west portal. Beginning in 1940, the Utah Construction Company bored more than 2 miles, excavating 12,227 feet of tunnel, continuing until work was halted 2 years later by order of the War Production Board.

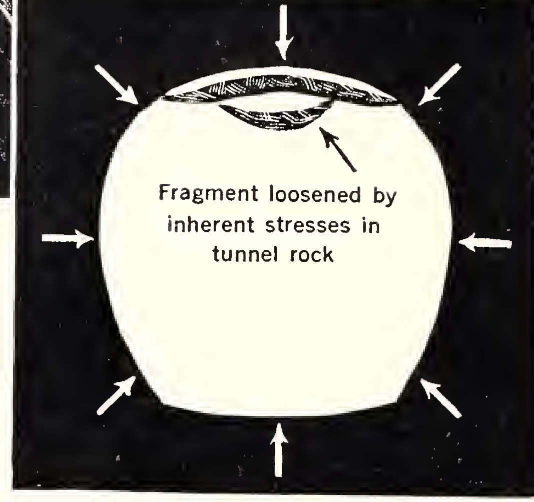
During the 7 years that elapsed before construction could be resumed, the weather treated the damp tunnel more severely than anticipated. Practically all of the old timber supports and lagging (protective planks placed between the steel tunnel supports and the rock walls of the tunnel)



MENACING MOISTURE—Water flowing at the rate of 14 second-feet is 18 inches deep in above photo of tunnel. Above right, Duchesne tunnel, showing cave-in area in old 6-inch steel sets. At right, aerial view of Deer Creek Dam and Reservoir, Provo River project, Utah, which will get water from the other side of the mountain as soon as Duchesne tunnel is completed. *Top photos by M. F. Edwards, right photo by Paul E. Norine, both of Region 4.*

HOT ROCK folded in under great pressure millions of year ago, now hard and cold, is shown above in this artist's drawing of a section of Duchesne Tunnel.

POPPING ROCK today is a result of this age-old condition. The drawing below is a simplified diagram of what happens when the rock begins popping.



in the 2.3 miles previously excavated had to be replaced for safety purposes. As a matter of fact, before starting the job, the contractors reconnoitered the diggings and found that the tunnel lagging had practically rotted away.

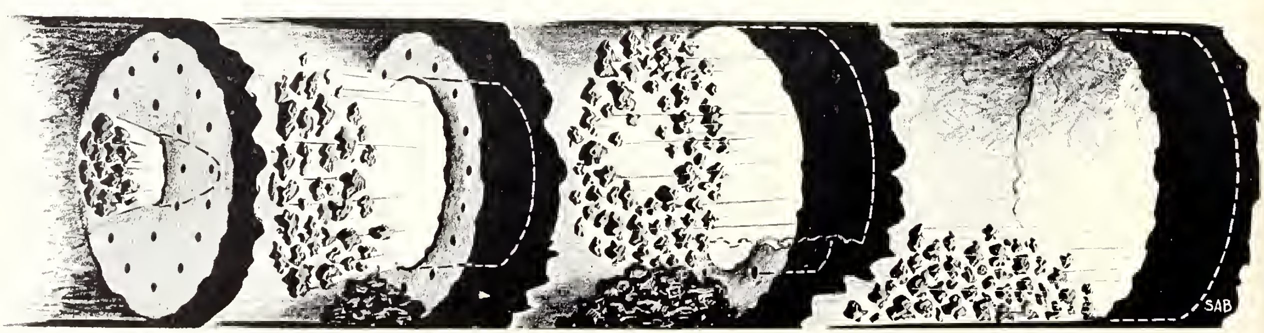
Water flows of up to 2.5 second-feet (1,145 gallons a minute) have been very troublesome. The water pours in from all angles. Weep holes must be drilled to drain off water pockets and relieve the pressure. Water removal has required thousands of feet of 20-inch Naylor pipe, three portable pumps, as well as a stationary pump (2,000-gallon capacity) with a 30-horsepower motor.

At the heading, watery seams acted as conductors and caused one dynamite explosion to start off another, causing practically a simultaneous explosion of all the shots rather than detonations a fraction of a second apart. Farmers will recognize this as another example of how water conducts the jar of an explosion. They often use only one detonator to explode several charges of dynamite spaced at intervals along a slough in order to form a drain ditch or clean silt out of a weir (see "Blast the Silt" on page 25 of the February 1951 issue of the Reclamation Era).

The contractor changed the timing of the blasts from millisecond (fraction-of-a-second) delays to delays of approximately a second or more between shots.

The Duchesne dynamite crews place the sticks of dynamite in drill holes arranged in concentric circles, setting off electric detonators with time

SLOW MOTION MOVIE showing the different phases in a dynamiting operation is represented in this stylized drawing. When the blasts were thrown off schedule at Duchesne by watery seams acting as conductors, a quite different and less orderly explosion occurred. *This, as well as the drawings at top of page, was prepared by the Graphics Section based on Region 4 data.*



fuses by one throw of the switch. The dynamite placed in the inner circles goes first, and the blast progresses to the outside circle. Although noisier and much more spectacular, it is reminiscent of what happens when you drop a stone in a quiet stream, and the ripples spread out from the center. What happens in dynamiting, however, is that a cone-shaped hunk of earth is broken loose, the blast beginning at the point of the cone, gathering force and material, and moving to the outer cone. The last shots to be fired are called "lifter" shots at the bottom of the section to be blasted. When the timing of these shots was thrown off by the wet ground, the unscheduled blasts heaved the rock as much as 100 feet back in the tunnel, greatly hampering mucking operations, and tearing out tunnel supports. Loosened wedges which floated in the knee deep water at times derailed the mine cars. Changing the timing (or millisecond delays) approximately a second or more between shots cured the problem in the wet ground. The split-second timing worked satisfactorily in dry, hard rock, producing cleaner breaks and better fragmentation.

Biggest sources of grief, however, have been the phenomenon of popping rock and the hardness of the rock. Although crews have worked around the clock, progress has been slowed to as little as 22 feet in 24 hours as compared to as much as 80 feet in the Palisade Grand Valley Tunnel. On the other hand, the popping rock advanced the heading for a distance of 4 feet at one time. Unfortunately, the contractors cannot depend upon it to pop in the right direction.

Popping rock is not unique, but it was somewhat of a surprise in the massive quartzite of the Duchesne Tunnel. Geologists believe that the rock was folded in under great pressure and at high temperatures, leaving stresses after cooling. When these stresses are relieved by the drill holes, the rock tends to explode by itself. On one occasion, the whole crew was blown off the drill jumbo. Fortunately, no one was seriously injured and scaling crews now go through the tunnel in advance of the drill crew to test the soundness of the area to be blasted.

Depth of drilling had to be reduced from 8 to 4 feet, and 6-inch steel horseshoe-shaped-**H** beams, placed 1 to 7 feet apart, had to be used to brace the rock right up to the face of the heading in order to alleviate the hazards of popping rock.

HOLING THROUGH POLE-HILL TUNNEL

FROM EAST AND WEST—They "holed through" Pole Hill Tunnel on March 15, 1951. After the final blast the usual handshakes from those on the two ends of the tunnel were exchanged. D. E. Cartee, hard-rock miner who helped set off the final blast, receives his handshake from J. H. Knights, district manager, Bureau of Reclamation. Looking on are (at extreme left) Robert Barkley, engineer, Northern Colorado Water Conservancy District, Greeley, Colo., J. M. Dille, secretary-manager, northern Colorado Water Conservancy District, Fort Morgan, Colo., Ren Read, assistant district manager, Bureau of Reclamation, and an unidentified miner. At the extreme right is K. W. Dickey, Bureau of Reclamation field engineer. The Wunderlich Company was the contractor for drilling the 5.6 mile tunnel, part of the Colorado-Big Thompson project, in record time. They started work in September 1949, and holed through in 75 percent of the time anticipated for this part of the job. *Photo by N. T. Novitt, Region 7 photographer.*

This has naturally slowed progress and increased costs.

Drilling through quartzite harder than granite is perhaps the chief drawback to progress, taking the job as a whole. The wear on men and steel is terrific even with modern carbide insert steel bits. Although tungsten-carbide bits are famous for wear, they have to be reground after 12 feet of hammering in the Duchesne Tunnel. It takes a crew from 1½ to 2 hours to drill out a single round as against about 25 minutes in the average tunnel of the same size. Special grinding wheels capable of sharpening 15 bits an hour are helping greatly in this battle of attrition.

Heavy snowfalls have not eased any of the construction problems. Outside the tunnel, mine car tracks have been covered with steel snowsheds clear to the dump. These sheds saved the contractors the almost impossible task of removing snow after each storm.

Obstacles like these have only made the lads who saved Grand Valley's peach crop set their jaws and pitch in all the harder. THE END.

DESCHUTES DOES IT AGAIN

WHEN IT COMES TO GROWING prize-winning ladino clover seed, Jefferson County farmers living on the 50,000-acre North Unit of the Deschutes project, one of the Bureau of Reclamation's newest developments in Oregon, have practically a monopoly. In the November 1949 issue of the RECLAMATION ERA we told how these farmers grew prize packages of clover seed in the article, "Deschutes Project—Deep in Clover." Last year returns from three major fairs in which growers had entered their ladino seed again confirmed their supremacy. Their 1950 accomplishments include firsts at the Oregon State fair at Salem, the International Livestock Exposition at Chicago, and the Royal Winter Fair at Toronto, plus a liberal number of lesser awards.

At the Oregon State Fair in Salem, North Unit farmers J. D. Welch, Jr., and Jim Brooks, took first and second prizes, respectively. At the big International Livestock Exposition in Chicago, the first and second place awards went to A. M. Pluemke and Lester Fletcher, respectively. The Royal Winter Fair in Toronto offered six prizes, all of which were taken by North Unit farmers. First prize went to J. D. Welch, Jr.; A. B. Starnes, second; Pete Bicart, third; Wiley Clowers, fourth; Lester Fletcher, fifth; and A. L. Clowers, sixth.

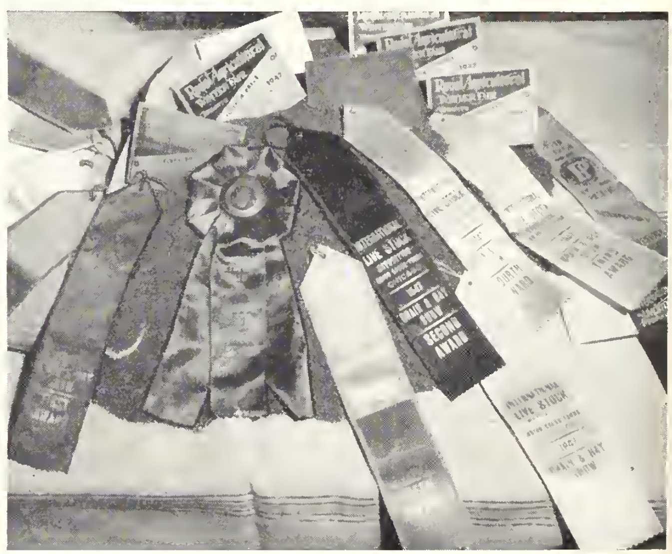
North Unit growers further added to their laurels in red clover competition also, with their Kenland Red samples scoring at Salem, Chicago, and Toronto. Recipients of prizes in this competition were at Salem, Jake Kollen, second prize; at Chicago, A. M. Pluemke, second; Lester Fletcher, fourth; and Ted Sleasman, eighth; and at the Canadian fair, Roy Stevenson, third; Lester Fletcher, ninth; A. L. Clowers, tenth; E. B. Randolph, twelfth; and Wiley Clowers, fourteenth.

Water was first delivered to North Unit lands in May 1946.

Ladino seed growers on the North Unit will long remember the fall of 1950 as one which almost cost them one-third of their seed harvest. Before the 1950 seedings and a substantial part of the older seedings could be harvested, the project area was lashed by heavy rains, severely damaging the Ladino clover seed crop and raising havoc with harvesting operations.

Through their hard work and ingenuity, the farmers finally overcame Nature's blow. They

RESULTS and REWARDS—Tom Miller examines Ladino clover on his irrigated farm near Metolius, Oreg. Ribbons were won for quality seed at expositions, fairs and other major events. ***Photos by Stanley Rasmussen, Region 1 photographer.***



ran the moisture laden crop through their combines and thrashers over and over until they had extracted a substantial yield and salvaged most of the crop. The harvest lasted until January 1951.

That their labors were rewarded is evidenced in the North Unit crop census for 1950, which reveals that the 16,136 acres of Ladino clover seed yielded 37,852 bushels, an average of 2.3 bushels per acre. This is still a good yield on most Ladino clover seed producing areas, but is considerably below previous yields on the North Unit.

Total value of the crop was $2,838,900, or a gross per-acre average of $175.94. THE END

California Farm Corporation Agrees To Dispose of Excess Land

Officials of Re-Al Farms, Inc., a San Joaquin Valley farm corporation, signed a contract on March 29, 1951, in which they agreed to dispose of all land in excess of 160 irrigable acres under provision of Reclamation law.

Under the contract, Re-Al Farms, in the Panoche Water District west of Fresno, agreed to dispose of excess acreage at a price determined by an appraisal board.

Under Reclamation law, an owner can receive Central Valley project water for only 160 acres of his holdings, unless a recordable contract is signed. Re-Al Farms, Inc., agreed to dispose of about 1,200 excess acres in the Panoche district. The contract allows the company ten years to conclude the sales.

The appraisal board is composed of three members, one appointed by the Bureau of Reclamation, one by the water district, and a third to be selected by the first two members. Under the contract either party can call for a reappraisal at any time before the final sale.

By signing the recordable contract for ultimate sale of the excess acreage, the entire Re-Al Farm acreage was made eligible to receive Central Valley project water. •

Hungry Horse Due for Round-Up

Secretary of the Interior Oscar L. Chapman announced on March 16, 1951, the award of a Bureau of Reclamation contract to complete Hungry Horse power plant. The Grafe-Shirley-Lane Co. of Los Angeles, Calif., won the contract for the installation of four giant 105,000-horsepower turbines and governors, and for the completion of the power plant and switchyard at Hungry Horse Dam on the Flathead River near Kalispell, Mont.

The hydraulic turbines are being manufactured by the Allis Chalmers Manufacturing Co. of Milwaukee, Wis., the four generators are being furnished and installed by the General Electric Co., Schenectady, N. Y., and governors for the power units are being provided by the Woodward Governor Co. of Rockford, Illinois.

Under the contract, the first of the four 105,000-horsepower turbines must be installed in time for the first 71,250-kilowatt generator to go on the line by October 1952. •

Second Annual Construction Engineers' Conference

Bureau of Reclamation construction engineers—the men who direct millions of dollars worth of Government field construction work each year—convened at the Denver Federal Center during the week of February 12–16 for the second annual construction engineers' conference on progress and problems in Reclamation construction.

The Bureau's Branch of Design and Construction in Denver, under the direction of Chief Engineer L. N. McClellan, was host to the gathering of about 60 of these top construction engineers.

During the week-long conference the problems of contract administration, labor regulations, equipment and machinery installation by contract, and other matters relating to the Bureau's contractual responsibilities were subject to critical review and open discussion. Engineering seminars on new developments and design, materials, and construction methods were also held for the program participants.

Emphasis this year was placed on construction quality, economy, and concentration of work to speed production of additional hydroelectric power and irrigation needed for the defense effort.

In addition to the construction engineers, representing virtually every important Reclamation project in the 17 Western States, several officials from Reclamation's Washington office

also attended the conference, among them Assistant Commissioner Goodrich W. Lineweaver; T. W. Mermel, engineering assistant to the commissioner; K. K. Young, of Mermel's staff; Director of Supply S. W. Crosthwait, and Programs and Finance Director A. R. Golze.

Discussions by Washington officials included addresses by Ansbert C. Skina, chief of the construction expediting branch of the Defense Power Administration, and George Atkinson of San Francisco, Calif., president of the Guy F. Atkinson Co., representing the Associated General Contractors of America. Mr. Skina outlined the situation regarding defense orders and the increasing shortages of materials.

Mr. Atkinson, who spoke on "Engineer-Contractor Relationships," told the conference he was pleased to note continuous improvement in relations between contracting agencies and contractors. In a frank discussion of the virtues and faults of various contracting agencies, he commended the Bureau of Reclamation for saving probably several million dollars during the last few years by improving its construction specifications.

Assistant Commissioner Lineweaver discussed the impact of the current emergency on the Bureau's construction program for the next fiscal year. He pointed out the likelihood of the program being keyed to power production and of the continuance of important irrigation work. He reminded the engineering conferees that the budget request affecting Bureau work in the 17 Western States is subject to decisions of congressional committees, but he could not predict what action they will take. The request is for a total sum for construction of about 225 million dollars, about 100 million dollars smaller than this year's request for construction appropriation. About 30 millions more is being requested for the Bureau for operation and maintenance, general investigations, and general administration.

BETWEEN SESSIONS—D. S. Walter, Bureau regional engineer at Boise, Idaho (extreme right), relates an amusing incident to fellow conferees at the construction engineers conference. Shown with him are (left to right): C. H. Spencer, construction engineer of the Hungry Horse Dam, Mont.; W. A. Dexheimer, Assistant Chief Construction Engineer, branch of design and construction, Denver, Colo.; and R. K. Durant, construction engineer, Friant-Kern Canal distribution system, Central Valley project, Calif.

The construction engineers' conference, like the first of its kind held here a year ago, was called at a time when field construction activities are at their lowest point because of weather conditions. THE END.

Lebanon Receives Point 4 Assistance From Reclamation Mission

A 10-man Bureau of Reclamation mission left the United States for Beirut on April 15 to help the Republic of Lebanon in the solution of its economic development problems. The mission will make a three-month reconnaissance study of Lebanon, a country about the size of Connecticut, lying north of Palestine on the eastern edge of the Mediterranean. Over a million people live in this 4,000-square-mile area, two-thirds of them in rural areas.

The mission will survey the 125-mile-long Litani River and its drainage basin, which has been called the "bank reserve" of Lebanon, examine potential dam sites, classify potentially irrigable lands, and determine the needs for water. The mission will also recommend action to reduce water pollution in the basin area, and will make a study aimed at a malaria-control program.

This project is the first phase of a cooperative Point 4 economic development plan, financed by the Technical Cooperation Administration, Department of State, which administers the Point 4 program under the International Development Act. The purpose of the plan is to help Lebanon increase both its industrial and agricultural output and raise its living standards.

The project is headed by Robert F. Hardman of Hardin, Mont., and includes Arthur F. Johnson, Mortimer R. Lewis, Ralph E. Winchell and Martin H. Fresen of the Bureau's Washington, D. C. office; Sumner B. Foster, Robert M. Ancell, and Eugene Wagonner from the Bureau's Engineering Center, Denver, Colo.; William W. Gorton from the Bureau's Boise, Idaho office; and Frederick Carlyle Roberts, Jr., of the United States Public Health Service, Dallas, Tex. •

SWAPPING KNOW-HOW—Former reclamation trainee, Dr. V. Amanda Rao, supervising engineer of the Irrigation Department of the Madras Public Works Department of India, points out engineering developments at an outdoor laboratory in Poondi, India, to United States Reclamation Commissioner Straus.

Commissioner Michael W. Straus and Chief Engineer L. N. McClellan of the Bureau of Reclamation were two of the United States delegates at five international conferences held in India last January: A meeting of the International Association for Hydraulic Research; a regional conference on Flood Control of the Economic Commission for Asia and the Far East; the World Power Conference; the Conference on Large Dams; and the International Commission on Irrigation and Drainage.

A total of 770 persons, 430 Indians and 340 from other countries, registered at these conferences.

Besides the many technical and official reports they are preparing as results of their trip, Mr. Straus has written a general account which will shortly be available through the Bureau of Reclamation, Denver Federal Center, Denver, Colo., attention 841. This account will include a summary by Mr. McClellan of the events and discussions at the conferences themselves.

RECLAMATION STREET—26,000 Miles Long

by MICHAEL W. STRAUS, Commissioner

Bureau of Reclamation

WHILE BATTLES RAGE AND SOLDIERS DIE, the oldest, bitterest war of all, whose casualties and misery have been inflicted on uncounted millions of human beings, is reaching an acute stage. It is the war of man against Nature for the means of survival.

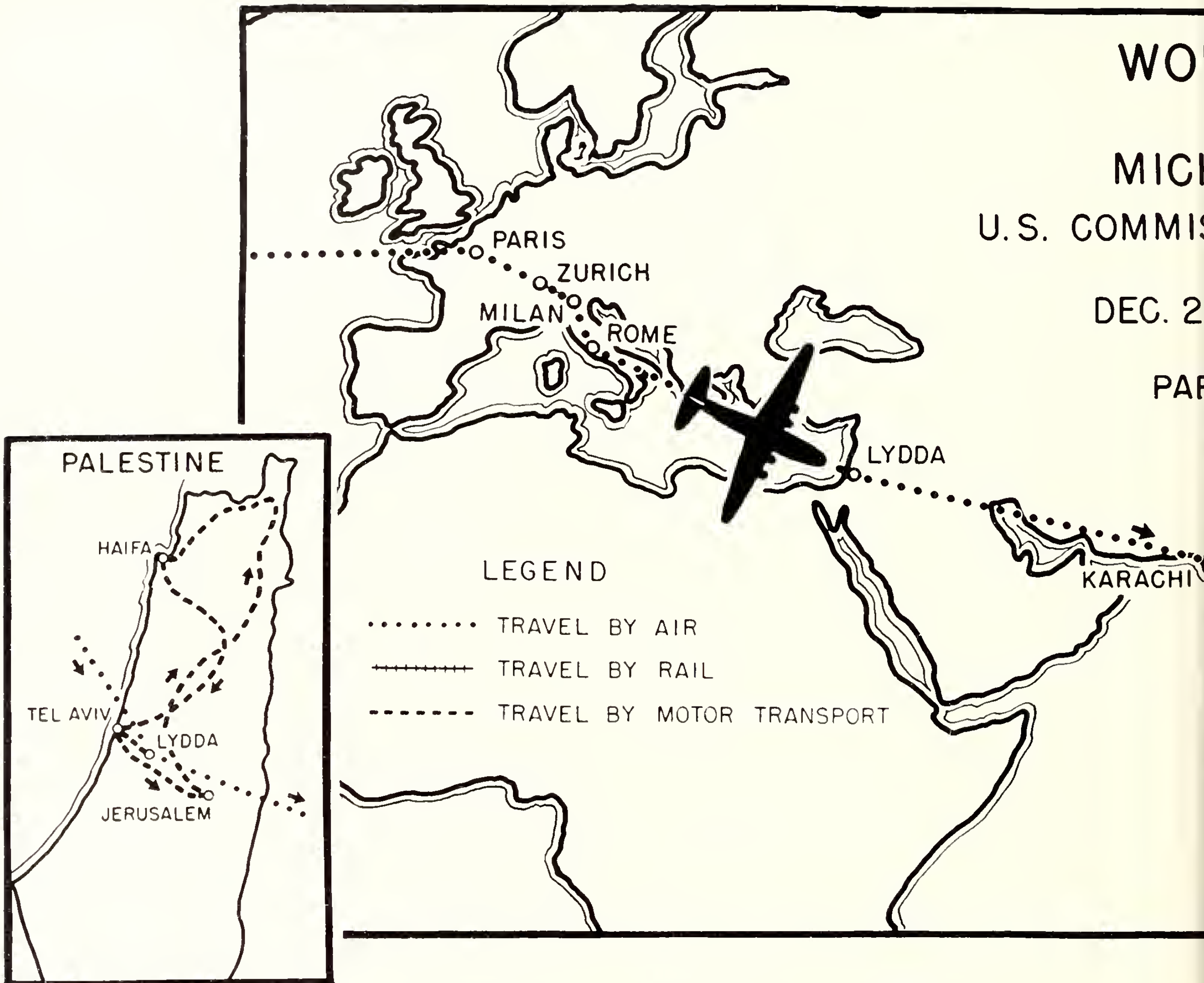
The earth's population is swiftly increasing. The rate of growth multiplies with the years. Yet means of feeding and clothing this new population lags far behind in the race with the birthrate. The results are starvation, exposure, disease, and unrest over large areas of the earth. Hunger has become the ally of tyranny.

But as America sends military aid to the defenders of liberty over land, sea, and air, so it is sending technical aid to help the teeming peoples of the under-developed areas win the war against want.

Vast reaches of these under-developed areas lie in the arid belt stretching round the globe—where deserts await only sweet water to grow food and clothing.

We are now helping to build a broad highway where once existed but a dim trail, marked by the green of irrigated crops round the arid belt of the world, and we can call it "Reclamation Street." We know it from Nebraska to California, in the United States, but it stretches on—26,000 miles round the globe.

On travels around the world this winter, I followed "Reclamation Street" through Italy and Israel, through Pakistan, India, and Ceylon, through Siam and Hongkong, the Philippines, Guam, and Hawaii. I found it perhaps better known on the other side of the world than in some of the eastern States of America.



I even found a symbolic sign reading "Reclamation Street" in English and Chinese, in the back washes of Hongkong.

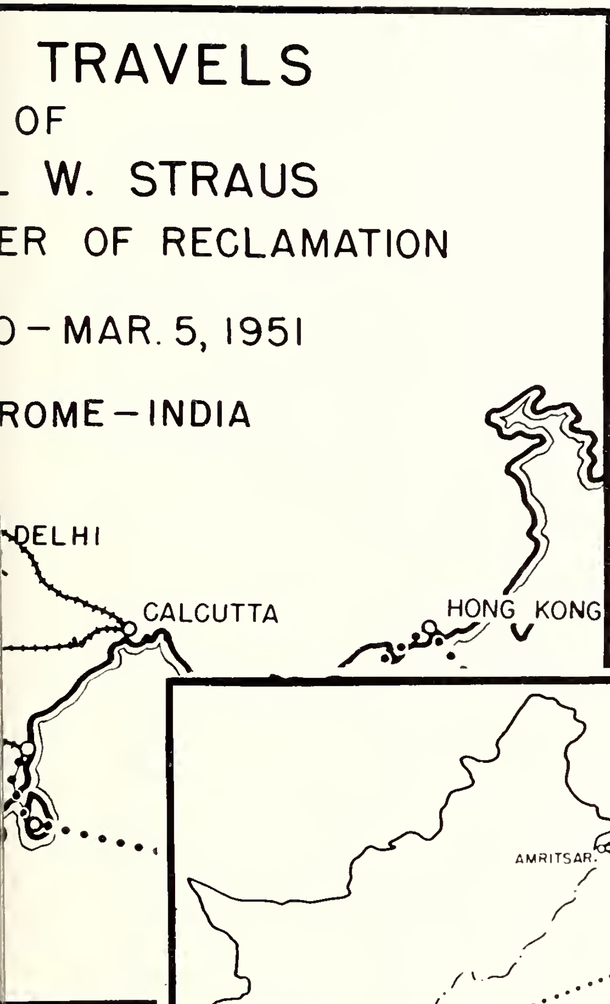
I came to realize that the Bureau of Reclamation is something more than a regional domestic governmental subagency which helps to bring greater prosperity and opportunity to seventeen water-short Western States. American Reclamation achievements have inspired hope all over the earth among peoples struggling against crushing odds to win some scant measure of decent well-being through their own efforts.

The people of the Far East have known the benefits of simple, and sometimes excellent, irrigation since the dawn of civilization. During uncounted generations they have been learning things which we only now are gratefully adapting to our own use in the American West.

More recently, those people have come to realize how modern, multiple-purpose projects, including the generation of hydroelectric power could win them more acres, increase their yields, and help them make or buy the many things they need. For technical help and knowledge in planning, building and operating such projects, they are turning to us of the American Reclamation movement.

We are eagerly supplying this technical help and knowledge, and find many of these countries equally eager to pay for the costs, within their means to do so. We find, too, valuable extra reimbursement from the technical knowledge we gain from the centuries of irrigation experience in many of these nations.

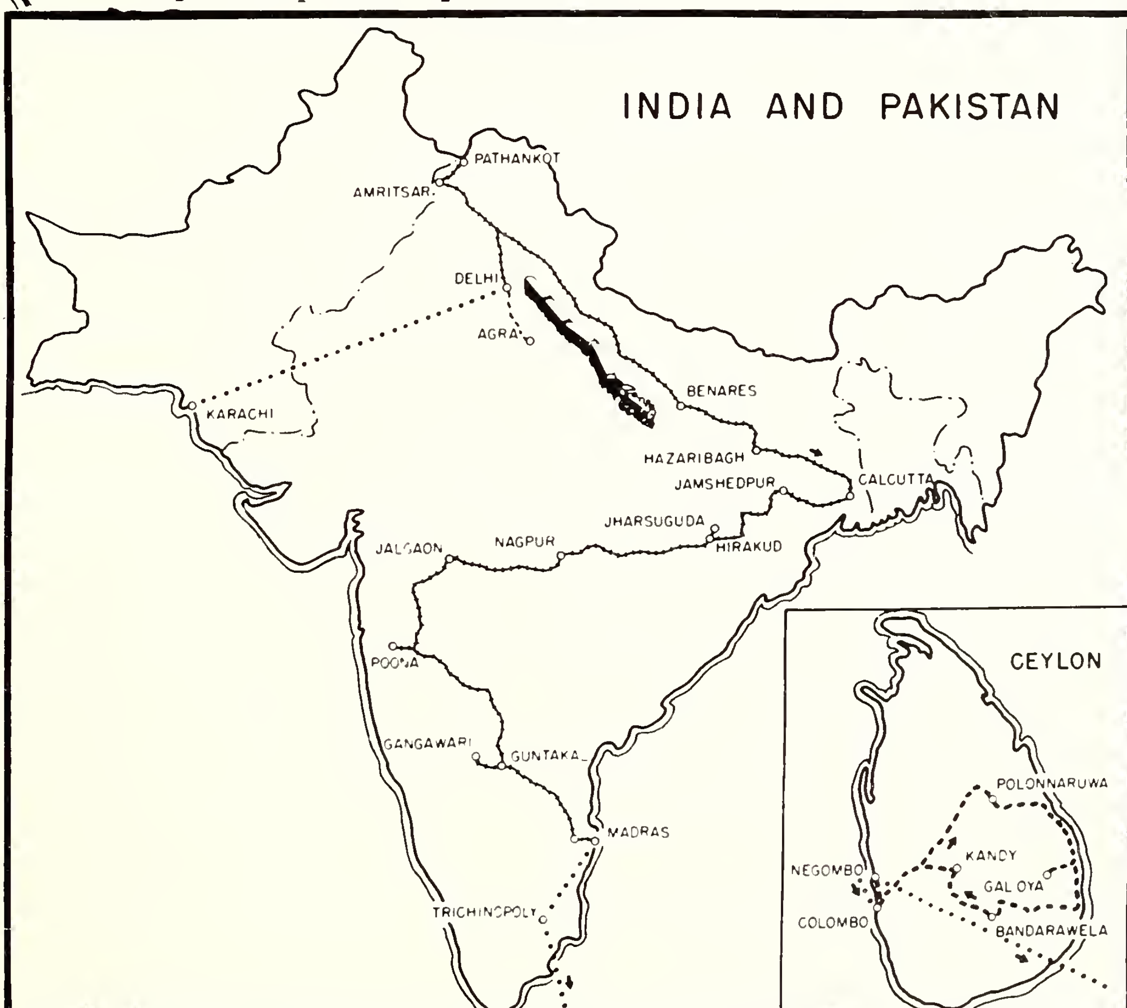
Through the Economic Cooperation Administration, the Department of State, and President Truman's Point Four program, the Bureau of Reclamation is making its publications and re-



searches available world-wide; has sent expert consultants to many undeveloped corners of Europe, the Near East, and the Orient; has trained 200 young engineers from 21 different Nations; performs special tests and researches; and makes its considerable resources of modern engineering know-how available to those who sorely need them.

Naturally, the American program comes first. The aid we give to other nations is all paid for by non-Reclamation funds, and is confined to what we can do without interfering with our own work in the West. The Bureau of Reclamation can perform only a fraction of the services that other nations would like to have from us.

Even that fraction, however, can constitute a significant contribution in the world's warfare against want. For our technical assistance falls like seed on fertile and receptive soils and yields manifold returns.



OUTDOOR LABORATORY in the Province of Madras, India, under inspection by Commissioner Straus, followed by Dr. Rao, and two other former trainees in reclamation, who are now leaders in Indian design engineering. Many irrigation and engineering techniques developed in India have been most useful to engineers in the United States and other countries.

On my trip, I found all South Asian countries embarking upon programs for developing their natural resources, and giving water and power developments first priority. They have the land, the water, the labor, the skill, and the determination. They lack money, equipment, and some kinds of training and technical knowledge. Though they are launching ambitious, forward-looking programs, it will be many decades before they have enough food, water and power to meet the minimum needs of their ever-increasing populations. Despite handicaps, they work courageously with what they have. They are trudging down Reclamation Street with their eyes fixed on distant goals.

The Reclamation Way in Italy

In Italy, almost 300 million dollars in the form of counterpart funds set aside by the Italian government to match American ECA aid, has been made available for water and power developments. Though little of this money has been put to use so far in actual construction, some worth-while projects in the Po River Valley, Sardinia, and Sicily have been designed and approved. One American ECA official closely in touch with the Italian program is Edward Corfitzen, formerly a Bureau of Reclamation engineer.

In Israel, it is not too much to say that this new nation's economy will stand or fall on its success in developing the waters of the Jordan River. Before Israel was created, and while the region was still under the British-Palistinian Mandate, the Bureau of Reclamation helped form a project plan for this river basin. However, the boundaries drawn between Israel and the surrounding and unfriendly Arab States have brought work on this plan to a halt. Hydroelectric developments already built lie in Arab territory and have been cut off, and at least partly wrecked, on the Arab side of the boundary. The Israeli are doing what they can through intensive water conservation measures and development of ground-water supplies; but their economy will continue to be precarious until and unless some way can be found to end disputes and develop the wasting waters of the Jordan.

Pakistan is another new nation born of battle; its boundaries drawn by truce with no regard to the geographical integrity of river-basins. Its 75 million people depend largely upon irrigation for economic survival, and its principal water resource is the great Indus River. However, some of the principal tributaries of this river arise in India.

Since bitter and still unresolved conflicts exist between these two new nations, the Indians are in a position to cut off the water from vital areas in Pakistan. Pakistan has completed excellent irrigation developments, some of them outstanding for their remarkably fine hydrology; however, its officials freely recognize that much more irrigation and power development is needed to establish a firm economy. If they could afford it, they would like to have help from the Bureau of Reclamation covering virtually every aspect of the Reclamation field.

Reclamation has already helped India by training many of her most outstanding engineers. As a result, Indians look principally to the United States for models of resource development, and they are eager to send us still more trainees and to have as much as they can of our technical aid.

(Next Month—From India to the United States)

Sumner P. Wing, Foreign Activities Leader, Dies Unexpectedly

Sumner P. Wing, who for the past 4 years has been in charge of foreign activities programs of the Bureau of Reclamation and who was preparing to personally lead an engineering team on a Point Four mission to Libya, died unexpectedly on Thursday, March 22, 1951, at the Group Health Association office, 1328 Eye Street NW., Washington, D. C. He was 60 years old and resided at 2801 Adams Mill Road.

Mr. Wing had been an engineer with the Bureau of Reclamation for 21 years. Since 1947, when he was appointed special representative to cooperate with the State Department, he served as liaison officer with irrigation representatives of foreign nations. The Reclamation program of engineering information and personnel exchange with the foreign governments has since been incorporated into President Truman's Point Four program.

Before coming to Washington, Mr. Wing was stationed at Denver, Colo. While there he was also active in foreign relations activities, winning a meritorious award for "establishing a closer working relationship and international good will between the Bureau and foreign governments who have had representatives working in or visiting this office." He had carried out a variety of domestic Reclamation engineering assignments, among which was work on the plans for the diversion tunnels and spillway bridges at Hoover Dam.

Prior to joining Reclamation, he was chief civil engineering designer and assistant to the chief engineer of the British Columbia Power Corporation for several years. He had also done engineering work in Italy and Korea. He was a member of the American Society of Civil Engineers and numerous other professional societies.

Born in Ithaca, New York, February 28, 1891, he was graduated from Stanford University and served as an engineering officer in the United States Army in World War I. He was the son of the late Charles D. Wing, formerly professor of structural engineering at Stanford University, Palo Alto, Calif.

From the State Department came the following message to Commissioner Straus from William C. Johnstone, Jr., Director of the Office of Educational Exchange:

> Members of my staff and I were distressed to learn of the sudden death of Mr. Sumner P. Wing. Those of us who have had the privilege of working with your office always found Mr. Wing a fair, understanding, and cooperative officer to deal with.
>
> We share with you the loss of a man who gave unstintingly of his talents, both as an engineer and as a Government official, to create a better world to live in; and who through his belief and actions championed the cause of international neighborliness and understanding.

L. N. McClellan, the Bureau of Reclamation's Chief Engineer, paid tribute to Sumner P. Wing in these words:

> The death of Sumner P. Wing was a shocking surprise to me and to all of us who had worked with him so long and with such great fondness.
>
> Sumner Wing came of a cultured background and was truly a gentleman, a fact which reflected itself in everything he did. We have lost a good friend. More than that, the loss to the Bureau of Reclamation is greatest because we are deprived of the services of a man who had profound knowledge, personally gained, of other peoples and other lands.
>
> While in charge of the reference library and of foreign activities in the Denver offices, Mr. Wing displayed genuine affection for the foreign visitors and trainees who came to his desk, extending himself generously to look after not only their technical or professional inquires but also their entertainment.

Mr. Wing's loss was described as a severe blow by Commissioner of Reclamation Michael W. Straus, who issued the following statement:

> The sudden and unexpected death of Sumner P. Wing is a loss not only to Reclamation development in the United States, but to irrigation and power development in many nations. In his long engineering career he performed outstanding services, but in recent years as administrator of many of the foreign contracts of the Bureau of Reclamation he became the friend and assistant of engineers in 20 foreign countries.
>
> Men who deal in water and power and the development of natural resources, regardless of race or color, as they came to this country seeking American aid, found their way to Mr. Wing's office in the Bureau of Reclamation. He gave unsparingly of his time and energy to helping them with their problems, securing for them the technical information that they wished and, in many instances, setting up missions from America to help them carry out their work in distant lands. He took a deep and almost paternal interest in the welfare of half a thousand engineers from overseas who in the last quarter of a century have come to take trainee courses with the Bureau of Reclamation.
>
> Mr. Wing's passing will be a sorrow to professional colleagues working to develop water of all continents, but a lasting monument to his endeavors are the structures that those he helped have built and will continue to build to serve mankind. ●

SHORT CUTS TO WEED-KILLING CALCULATIONS

PART TWO—Finding the Killer in the Dust

This is the second in a series of articles based upon the bulletin, Handbook of Weed-Control Calculations, prepared by John T. Maletic, soil scientist and weed specialist of the Bureau of Reclamation's Region 7, headquarters at Denver, Colo. In part one we explained how to use Figure 5 in the Handbook, which was entitled, "Nomogram for Determining the Cost of One Pound of Active Ingredient in Liquid Herbicides" which can help you get the most for your money when you are buying liquid weed killers.

Here is figure 4 from the handbook. Despite the imposing title, "Nomogram for Determining the Cost of One Pound of Active Ingredient in Solid Type Herbicides," this is a handy chart to help you find the "killer" ingredient when you buy a powdered herbicide or weed killer, such as 2,4-D, TCA, or a chlorate. This chart may also come in handy if you are buying a can or drum of insecticide or fungicide—but only if one principle active ingredient (or the part that does the killing) is involved. All-purpose chemicals for controlling insects or plant diseases, or both, contain several active ingredients and therefore this nomogram would not be applicable.

Now let us suppose you have made your plans to dust a weed-infested area, or insect- or disease-infested crops. Perhaps you are going to dust by airplane. (If you are using 2,4-D, you would of course keep in mind the fact that dusting 2,4-D by plane is frowned upon because of the danger of it drifting to cropland, and this practice is prohibited by law in many States. This problem is now being studied and some progress has been made in using pellets of 2,4-D, to bombard the earth before plants have appeared. Pelleting 2,4-D eliminates the danger of drift.) Perhaps you plan to use a dusting or blowing machine which will blow dust on the growing plants, at whatever angle you have decided is best—depending upon the set of the dusting nozzles. Or you may plan to use a spreader, the same machine you use for applying lime or fertilizer, for dusting the ground and preventing weeds from appearing at all.

For the sake of illustration, let us suppose you have decided upon 2,4-D for your job. You will not be able to find a can, bag or drum of concentrated powder which contains 100 percent active ingredient—for the simple reason that it costs too much to refine the chemicals, and furthermore you could not spread it around on your crops or land. As in liquid herbicides, the solid types often have materials in them, such as talcum, powdered clays or other solid materials, called "carriers," which are not harmful or toxic to plants, but which break up the active ingredient so a small amount can be spread evenly over a large area. You would not want to use an herbicide, insecticide or fungicide full strength, nor would you be able to do so.

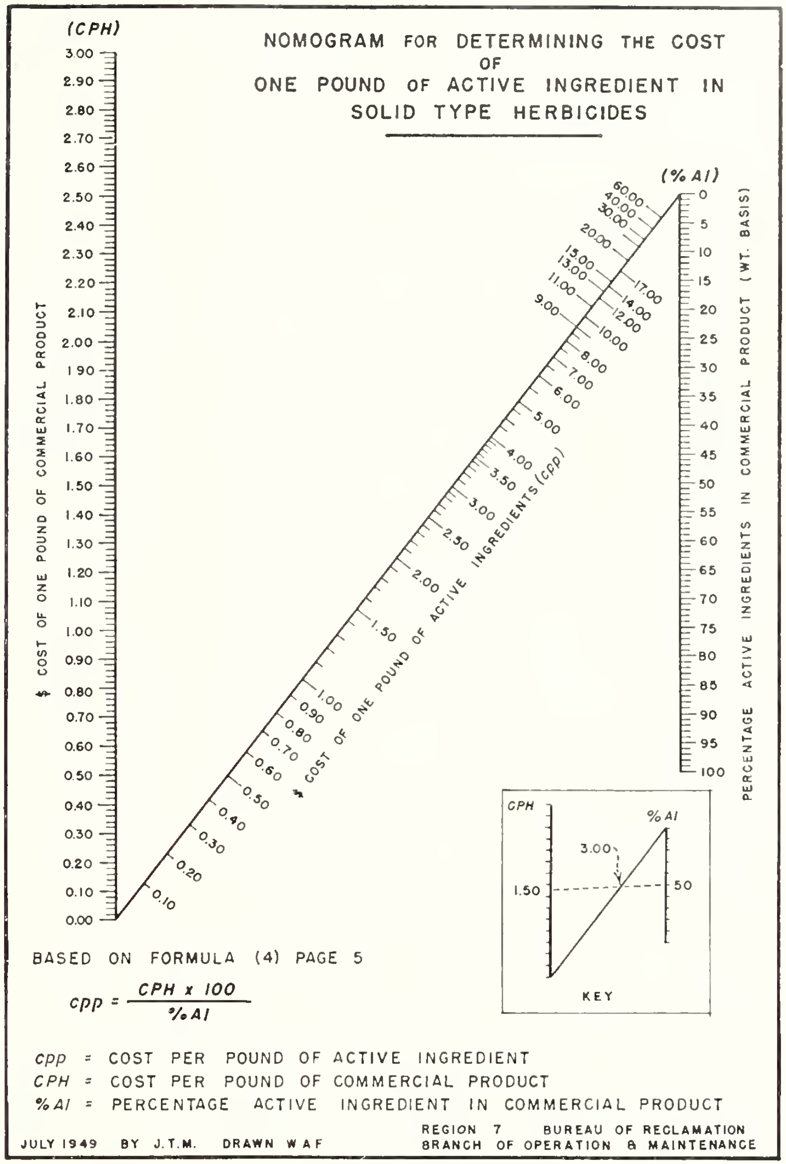
Therefore, what you want to find out is how much you are paying per pound for the chemical which is actually doing the job for you—the active ingredient.

For your convenience, we are having this series of nomograms reprinted, and you may obtain them upon request from your nearest Bureau of Reclamation Regional Director, or the Commissioner's office in Washington, D. C. So when you go to the store, you may have this nomogram tucked in your pocket, ready for your use in comparing the prices and active ingredients of the various brands and packages.

The left hand vertical scale of the nomogram is headed CPH (which represents the cost of one pound of the commercial product). The reason for using the initials CPH rather than CPP for Cost Per Pound is to avoid confusion. The answer you are looking for is CPP—cost per pound of active ingredient. Think of Cost Per Herbicide (or Insecticide or Fungicide, if you can use this chart for that purpose) when you look at the left-hand scale on the nomogram, and of the price tag converted to the cost per pound of the commercial product.

The right hand scale, headed % AI, of course means percent of active ingredient in the commercial product on a weight basis. You can easily figure out the cost per pound of the 2,4-D, and the label should tell you what percent of the dust or powder in the container is "active ingredient."

RAPID CALCULATION METHOD—In John T. Maletic's "Handbook for Weed Control Calculations" on page 96, he explains the use of nomograms like the one at right. Alinement charts like these afford a convenient method of making weed-control calculations. The principal advantages of the nomograms are the rapidity and simplicity with which the calculations can be made. Unskilled individuals can perform computations with a nomogram as readily as anyone. Because of the wide range of values involved in the nomograms precise answers should not be expected. The nomograms reproduced in this series will therefore give approximate answers which are within the limits of accuracy obtained by the actual field applications of the herbicides. In using the charts, scales can be more easily read if a transparent straightedge is used. For accuracy the straightedge should always precisely intersect the value involved.



Now, to find out how much one pound of the actual active ingredient costs, you catch the figure on the slanting line, between the two figures you already have.

Suppose you find that a 10-pound package of 2,4-D costs $15. That would make it $1.50 per pound. Now you have the figure for the CPH column. The label states that the package contains 50 percent active ingredient. Merely place one end of your straightedge precisely at the $1.50 of the CPH scale, and slide the other end around until it is precisely at 50 on the right-hand scale—percent AI. If your straightedge is aligned properly, it should intersect the diagonal line at 3. Your active ingredient costs you $3 per pound.

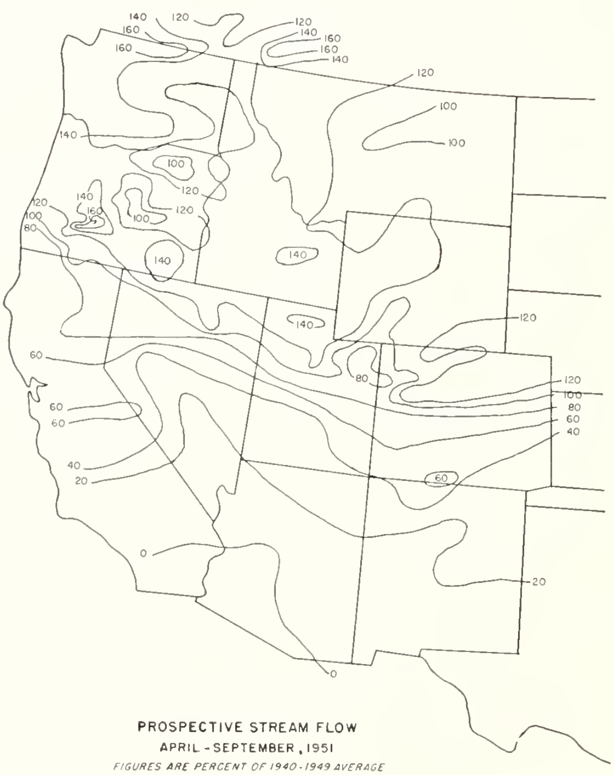
Another brand of 2,4-D costs only $14 for 10 pounds, or $1.40 per pound (CPH), which might seem cheaper. But the label states that it contains 30 percent active ingredient. When you connect the figures 1.40 on the CPH scale and 30 on the percent AI scale, take your pencil and make a dot where the straightedge crosses the diagonal line. You will find it halfway between 4 and 5, which means your active ingredient is costing you $4.50 per pound. You would have to use considerably more of the second product to get the same results, and it would cost more in the long run. Buying the $15 bag of TCA with the 50 percent active ingredient would really be cheaper and more effective than buying the $14 bag with the 30 percent active ingredient. •

WATER REPORT

OUTLOOK FOR 1951 WATER SUPPLY OF THE WEST

by CLYDE E. HOUSTON, Irrigation Engineer, Soil Conservation Service, Reno, Nev., and R. A. WORK, Senior Irrigation Engineer, Soil Conservation Service, Medford, Oreg.

This year the pattern of plenty or little (water, that is) covers the West like a variegated quilt. The old, and never settled, question of weather cycles again has popped up. When will the Southwest drought relax its damaging and expanding grip? Will nature continue her generous water gifts to Columbia's fertile basin? The writers venture no opinions as to long-terms answers to such vital questions. However, it might be interesting to recall that Sir Francis Bacon in his writings of 1625 AD referred to a 35-year weather cycle. Douglas, a very able research student, identified a master 270-year weather control cycle which he said contained sub-cycles, one rather strong, of 14 years. Gillette, from his silt-layer studies of ancient lakes, asserted existence of a rigid 152-year rainfall cycle. Harding, from his ingenious studies of inflow to land-locked lakes, concluded exact weather cycles to be unpredictable, but of course conceded the well-known existence of alternating periods of scanty or copious precipitation. Thus, in general, it seems that skilled interpreters of historical precipitation records fail to agree. How, then, are we laymen to project nature's past performances dependably into the future?



PROSPECTIVE STREAM FLOW
APRIL - SEPTEMBER, 1951
FIGURES ARE PERCENT OF 1940-1949 AVERAGE

Well, the snow surveyors conservatively project nature's performance during the winter months into usable and dependable forecasts of water supplies for the following irrigation season. That seems to be about as far as science today can successfully carry us, in lifting the veil from the hydrologic future.

So let's see how the snow surveyors size up the immediate prospect for 1951.[1]

In the following paragraphs the water supply outlook is reviewed State by State.

Arizona—Arizona is entering its main irrigating season with one of the poorest outlooks for water in almost a half century of record. Streams flowing into the major reservoirs of the State have carried miserly base flow during the entire runoff season. The reservoirs of the State now store water only to 7 percent of capacity. No further runoff from snow melt can be expected. Snow cover, short all winter, has for the most part been dissipated by high winds. February through June runoff into the major reservoirs will be approximately 16 percent of normal, totaling about 140,000 acre-feet of water.

The water allotment in the Salt River project has been cut to 1½ acre-feet per acre. This means that irrigators will have to cut their acreage one-third to one-half in order to insure marketable crops. The Gila River project will have one-half acre-foot of water per acre of land at Coolidge Dam. However, considering seepage losses, the delivered amount will be still less. Most of the farmers in the Gila River project are planting only 20 percent of their land and many others are not planting at all. The Gila River will probably be a dead stream by May 15. Pumping costs in both the Gila and Salt River Basins will be

[1] The Division of Irrigation and Water Conservation is the Federal coordinating agency of snow surveys conducted by its staff and many cooperators, including the Bureau of Reclamation, Forest Service, National Park Service, Geological Survey, various departments of the several western States, irrigation districts, power companies, and others. The California State Division of Water Resources conducts and coordinates snow surveys in that State, while the British Columbia Department of Lands and Forests, Water Rights Branch, has charge of the snow surveys in that province.

greater this year due to the most recent 10-foot recession in ground-water level.

The Maricopa Water Conservation District, which distributes the water from Carl Pleasant Dam (capacity 179,000 acre-feet) will receive no surface flow and will have to rely entirely on pumped water. The pump head here now exceeds 300 feet.

The Little Colorado River has experienced practically no runoff all season.

The State, as a whole, will probably enter the winter months of 1951–52 with as little reservoir storage as ever recorded.

CALIFORNIA—California's 1951 summer water supply will be deficient. Snow pack is definitely below normal over the entire length of the Sierras. On the Kern and Kaweah watersheds less snow exists as of April 1 than in the year 1931 and 1934. This is the driest season since comprehensive snow surveys began on those watersheds 22 years ago. Summer flow of Kaweah and Kern Rivers will apparently be less than that of 1924, which was the lowest summer-flow year of record. The greatest deficiencies of summer flow are expected on streams that experienced their highest flood crest of record following the storms of November and December.

The snow pack on the upper Sacramento River gives promise of the best percentage of normal flow for any of the Sierra streams. However, even on this watershed runoff, only 80 percent of normal is expected. Reservoirs are now at favorable stages, and most should fill during the early spring runoff. However, the large multipurpose reservoirs such as Shasta and Millerton probably will not fill. Lake Tahoe is expected to reach 6,228.7 ft. elevation, the highest since 1946.

No significant rain has occurred in California since March 9 and at the time of this report the drought continues. Unless substantial rain occurs during April and May, summer flows forecasted herein will have to be revised downward.

COLORADO—Mountain snow cover is well above normal along the Continental Divide in the northern part of Colorado. In western Colorado the high-elevation snow cover is slightly below normal. In southern Colorado the snow cover is definitely deficient. Runoff during the snow-melt season should be well above average on the South Platte and its tributaries, on the main stream of the Arkansas and on the upper Colorado River. On the Yampa, White, and Gunnison rivers the summer runoff will be about normal. On the Dolores, San Juan, Rio Grande, and the southern tributaries to the Arkansas the summer runoff is not likely to exceed 50 to 60 percent of average. Soil moisture conditions are only fair in irrigated areas especially in the San Juan and Rio Grande basins where the soil is extremely dry.

IDAHO—All the rivers in Idaho, with the exception of Lost River, have snow water stored in the mountains varying from 5 to 30 percent above normal. This general condition assures above-average water supplies for irrigation and power throughout the State. Some snow melt during February has kept stream flow above average. Storage in some reservoirs has been lowered in anticipation of fair to good water supplies yet to come.

The high-altitude snow courses are showing relatively higher snow water content than the courses at lower elevation. This condition may promote more sustained and dependable flow of water throughout the State than usually occurs when low-elevation snow cover is heavy.

MONTANA—Snow pack on the upper Missouri River Basin is somewhat above average and should provide good irrigation water supplies in 1951. The pack this year is not quite as great as in 1950 or 1949, but is greater than in 1948. Thus, potential flood hazard in parts of the basin should not be overlooked. Due to orderly snow melt, controlled stream flow resulted in 1949 and 1950. The 1948 melt season was accompanied by high temperatures and precipitation in such amounts as to cause rapid snow melt, which produced floods on most rivers and tributaries. Consequently, realization of the 1951 flood potential will depend entirely upon meteorological events in the basin during the next 2 or 3 months.

Upper Columbia River Basin in Montana also shows above-normal snow pack this season. Potential flood hazard of modest proportions now exists on some headwater streams of Columbia River in Montana. The magnitude of this potential depends entirely on melting conditions during the snow-melt season. In any event, very good water supplies for the basin are foreseen.

NEVADA—The drought of the Southwest is continuing its move northward into Nevada and at this time it encompasses the southern two-thirds of the State and the eastern slope of the Sierra Nevada. The only bright spot is the Humboldt River which is expected to flow 150 percent of normal. The floods of last November and December were a blessing in disguise, for they filled reservoirs and mountain and valley soils. Runoff of snow-stored water will be less than 50 percent of normal from the Sierra while the central and southern part of the State will realize only from 10 to 25 percent of normal. Storage in Lake Mead equals 95 percent of last year but less than 90 percent or normal for this date.

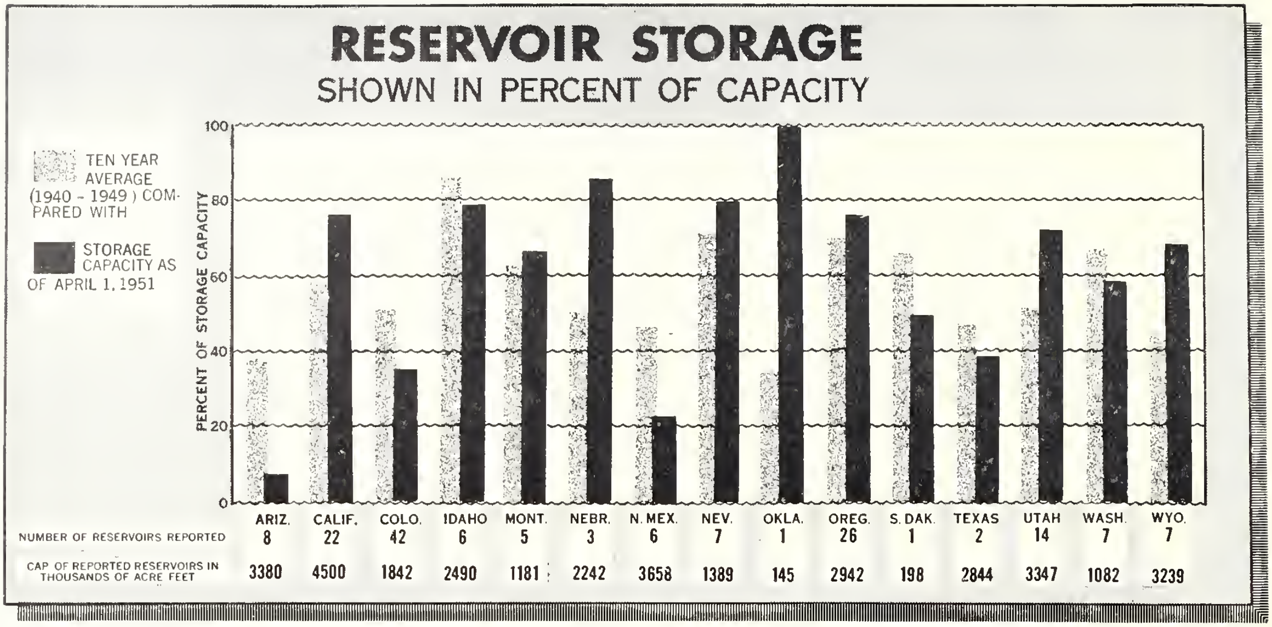
NEW MEXICO—A critical shortage of irrigation water is foreseen this season for lands along the Rio Grande. Snow cover in northern New Mexico is very deficient with many snow courses showing the least since surveys were started in 1937. The summer flow of the Rio Grande through New Mexico will not exceed 25 percent of the irrigation water demand. El Vado Reservoir, supplying the middle Rio Grande area, is practically empty. Storage in Elephant Butte Reservoir and Caballo Reservoir is about 400,000 acre-feet. This amount will supply about one-half of the normal irrigation-water demand in the lower Rio Grande valley. Considerable amount of crop curtailment will be necessary. Soil moisture conditions in all irrigated areas are reported as dry.

OREGON—Water supply for 1951 will be generally good to excellent. Reservoir storage for the entire State, with few exceptions, will be adequate. Many reservoirs will hold substantial reserves at the conclusion of the 1951 season. Owyhee Reservoir now holds 2 years' supply and is full for the first time since 1946. The only appreciable snow shortage on watersheds is in extreme southern and southwestern Oregon. Runoff is expected to be above normal throughout the State except for Applegate and Illinois rivers in southern Oregon and in the Grande Ronde, Umatilla River, and northern Harney valleys. However, flows in the latter three areas should be nearly average.

SOUTH DAKOTA—Snow cover in the Black Hills has been deficient all winter. The water supply outlook is not much better than fair. Soil moisture conditions in the irrigated areas are reported as dry. Belle Fourche Reservoir now stores 94,000 acre-feet as compared to 93,000 acre-feet a year ago and 127,000 acre-feet for the 10-year average (1940–49). Angostura Reservoir, newly operating, with a total capacity of 160,000 acre-feet, has now filled to 32,000 acre-feet.

UTAH—Extreme variation is shown in the water supply prospects for Utah during 1951. Severe drought faces all water users in the southern half of the State, with water supplies varying from 25 to 45 percent of the preceding 10-year average. In northeastern Utah on Ashley Creek, the Whiterocks, and Uinta rivers, streamflow will be 65 to 70 percent of average. Northwesterly from these areas, water supply outlook increases to as much as 40 percent above average as indicated by the snow blanket on the Cache and northern Wasatch forests. In these watersheds above-normal temperatures during the melt period could produce damaging peak flows. Reservoir storage supplies are excellent in northern Utah. In southern Utah, low reservoir storage will increase the severity of the water shortage.

WASHINGTON—Prospects for water supplies in Washington are fair to good. Water stored in snow ranges from 5 to 50 percent above normal. Snow cover



Most State averages for reported reservoirs are for full 10-year period, but in a few cases reservoirs having shorter records are included. CALIFORNIA—does not include Millerton or Shasta reservoirs (combined capacity 5,020,500 acre feet) April 1 combined storage 4,011,000 acre feet. COLORADO—does not include John Martin reservoir (capacity 685,000 acre feet) April 1 storage 80,800 acre feet. MONTANA—does not include Fort Peck reservoir (capacity 19 million acre feet) April 1 storage 12,960,000 acre feet, also does not include Flathead Lake (capacity 1,791,000 acre feet) April 1 storage 651,600 acre feet. NEVADA—does not include Lake Mead (capacity 27,217,000 acre feet) April 1 storage 16,806,000 acre feet. OKLAHOMA—new reservoir 1945. WASHINGTON—does not include Roosevelt Lake (capacity 5,220,000 acre feet) April 1 storage 4,749,000 acre feet.

on the Methow River drainage is 50 percent above average. This implies a serious threat of high water if a cold spring should now occur and delay snow melt until late in the season.

Water stored as snow in British Columbia (nearly one-half of the flow of the main stem of the Columbia River comes from British Columbia) is slightly greater than at this time in 1950, being 30 percent above normal. However, water stored in snow on other rivers contributing to the Columbia, is generally less than in 1950. Even so, a cold late spring coupled with heavy precipitation would cause serious high water on the Columbia again.

WYOMING—The irrigation water supply outlook for both the Green and North Platte River watersheds in Wyoming is excellent. On the Green River the snow cover is 150 percent of normal. Soil moisture conditions are reported as excellent. The summer discharge of the Green River will probably not be as high as a year ago because of the heavy snowfall during April 1950.

On the North Platte drainage the snow cover is about 110 percent normal and on the Laramie drainage about 130 percent. The irrigation water supply for lands below the major reservoirs on the North Platte is assured. Storage in these reservoirs is now about 1,700,000 acre-feet. This is a record high storage and represents two times the past 10-year average. Soil moisture conditions in the upper Laramie valley and in the Wheatland area on the same stream are relatively poor. Similar soil moisture conditions exist along the North Platte in eastern Wyoming and western Nebraska.

Snow covering the high watershed of the Snake River in western Wyoming varies from 24 to 27 percent above normal as of April 1. This insures the Jackson Hole area and adjacent lands below in Idaho of a good water supply for the 1951 season. Very good water supplies are foreseen for northern Wyoming, including Yellowstone, Wind, Big Horn, Tongue, and Powder river basins.

BRITISH COLUMBIA—Water supply prospects for southern British Columbia are very good and far better than average. The Okanogan and Kootenai areas can expect unusually high runoff. Orderly snow melt has already started, but since snow cover is far above average, any interruption of the spring thaw by unseasonably cold weather would almost surely result later in extremely high flows. The flood potential must therefore be recognized although it cannot be so clearly defined now as a month hence. If the present thawing weather continues through April, the flood potential will be materially lessened by May first. However, in any event, quite high flows are in prospect for Kootenai and Okanogan rivers due to the tremendous snow pack on those watersheds.

THE END.

Here are a few items not covered by Mr. Work's report. Deerfield reservoir, on the Rapid Valley project in South Dakota, with a capacity of about 15, 000 acre-feet, may spill this year, an item of special significance as the Bomber Base at Rapid City depends upon Rapid Creek's water supply. North Dakota's Dickinson and Heart Butte reservoirs are both full (storing 7,000+ acre-feet, and 200,000 acre-feet, respectively).

Water Stored in Reclamation Reservoirs

Location	Project	Reservoir	Storage (in acre-feet)		
			Active capacity [1]	Mar. 31, 1950	Mar. 31, 1951
Region 1	Baker	Thief Valley	17, 400	11, 000	18, 100
	Bitterroot	Lake Como	34, 700	20, 000	20, 000
	Boise	Anderson Ranch	464, 200	133, 000	329, 800
		Arrowrock	286, 600	172, 100	167, 700
		Deadwood	161, 900	107, 300	109, 100
		Lake Lowell	169, 000	152, 400	157, 600
	Burnt River	Unity	24, 600	6, 500	15, 000
	Columbia Basin	F. D. Roosevelt	5, 220, 000	4, 555, 000	4, 749, 000
	Deschutes	Crane Prairie	50, 000	47, 000	53, 000
		Wickiup	182, 000	185, 300	188, 000
	Minidoka	American Falls	1, 700, 000	1, 527, 800	1, 389, 200
		Jackson Lake	847, 000	449, 600	459, 600
		Lake Walcott	95, 200	87, 000	89, 200
		Grassy Lake	15, 200	13, 200	13, 200
		Island Park	127, 300	127, 800	115, 000
	Okanogan	Conconully	13, 000	7, 500	7, 600
		Salmon Lake	10, 500	6, 600	10, 000
	Owyhee	Owyhee	715, 000	526, 500	715, 000
	Umatilla	Cold Springs	50, 000	45, 400	50, 000
		McKay	73, 800	66, 400	64, 300
	Vale	Agency Valley	60, 000	33, 200	32, 900
		Warm Springs	191, 000	48, 200	82, 600
	Yakima	Bumping Lake	33, 800	11, 700	5, 200
		Cle Elum	435, 700	267, 700	256, 700
		Kachess	239, 000	187, 600	174, 700
Region 2		Keechelus	153, 000	71, 500	65, 900
		Tieton	197, 000	110, 200	106, 200
	Central Valley	Millerton Lake	500, 000	184, 500	339, 400
		Shasta	4, 366, 800	3, 339, 800	3, 525, 200
	Klamath	Clear Lake	513, 300	149, 300	139, 300
		Gerber	94, 300	41, 400	57, 600
		Upper Klamath Lake	524, 800	414, 100	441, 300
Region 3	Orland	East Park	50, 600	49, 200	49, 300
		Stony Gorge	50, 000	42, 500	51, 000
	Boulder Canyon	Lake Mead	27, 207, 000	17, 686, 000	16, 806, 000
	Parker	Havasu	688, 000	663, 400	605, 700
	Salt River	Bartlett	179, 500	59, 700	6, 000
		Horse Mesa	245, 100	227, 100	136, 000
		Horseshoe	144, 000	2, 300	1, 000
		Mormon Flat	57, 900	51, 200	54, 000
Region 4		Roosevelt	1, 381, 600	276, 100	5, 000
		Stewart Mountain	69, 800	48, 800	48, 000
	Fruit Growers	Fruit Growers	4, 500	4, 200	3, 000
	Humbolt	Rye Patch	179, 000	55, 400	109, 100
	Hyrum	Hyrum	15, 300	10, 600	10, 300
	Moon Lake	Moon Lake	35, 800	20, 800	20, 500
	Newlands	Lahontan	290, 900	185, 700	234, 600
		Lake Tahoe	732, 000	228, 000	592, 800
	Newton	Newton	5, 300	4, 900	5, 100
	Ogden River	Pine View	44, 200	5, 800	10, 200
	Pine River	Vallecito	126, 300	55, 100	27, 100
	Provo River	Deer Creek	149, 700	117, 800	124, 100
	Scofield	Scofield	65, 800	25, 200	32, 200
	Strawberry Valley	Strawberry	270, 000	119, 500	141, 500
	Truckee River Storage	Boca	40, 900	16, 100	19, 400
Region 5	Uncompahgre	Taylor Park	106, 200	72, 600	51, 100
	Weber River	Echo	73, 900	43, 900	48, 200
	W. C. Austin	Altus	145, 000	119, 900	145, 000
	Balmorhea	Lower Parks	6, 000	6, 500	6, 600
	Carlsbad	Alamogordo	131, 900	102, 000	81, 800
		Avalon	6, 600	3, 200	1, 100
	Rio Grande	Caballo	345, 900	220, 800	154, 200
Region 6		Elephant Butte	2, 197, 600	655, 900	255, 200
	Tucumcari	Conchas	269, 100	209, 600	182, 500
	Belle Fourche	Belle Fourche	185, 200	93, 000	94, 300
	Milk River	Fresno	127, 200	17, 700	99, 900
		Nelson	68, 800	5, 700	16, 700
		Sherburne Lakes	66, 100	39, 000	30, 500
	Riverton	Bull Lake	155, 000	6, 200	79, 500
		Pilot Butte	31, 500	13, 600	13, 800
	Shoshone	Buffalo Bill	394, 600	169, 400	269, 100
	Sun River	Gibson	105, 000	46, 600	80, 600
Region 7		Pishkun	30, 100	18, 800	18, 900
		Willow Creek	32, 400	3, 800	26, 000
	Colorado-Big Thompson	Green Mountain	146, 900	68, 400	54, 800
	Kendrick	Alcova	190, 300	154, 300	169, 500
		Seminoe	993, 200	518, 800	491, 700
	Mirage Flats	Box Butte	30, 600	26, 400	23, 500
	North Platte	Guernsey	44, 200	25, 100	39, 700
		Lake Alice	11, 000	3, 500	----------
		Lake Minatare	60, 800	24, 200	25, 400
		Pathfinder	1, 040, 500	915, 000	963, 300

[1] Available for irrigation.

LETTERS

An Acknowledgment From Africa

University of the Witwatersrand
Milner Park, Johannesburg
South Africa

I was pleased to receive, through the American Consul General, your letter 220 of November 29, 1950, which reached me only a short time ago on my return to Johannesburg. The recording of the "Voice of America" broadcast of October 3, 1950, and the copies of the Reclamation Era have arrived and add to the pleasure felt by me on reading your kind letter of November 29. I feel it is a great privilege to have once more had the opportunity of studying the methods and work of the Bureau of Reclamation and I greatly value the benefits I have derived from my discussions and contacts with you and members of your staff. My memories of my period of training in 1921–22 and my recent studies of the work of the Bureau of Reclamation are vivid and enduring and the experience gained on each of these occasions brings to me an obligation to assist and affords a means of assisting in the development of the Union of South Africa. In concluding this brief letter of acknowledgement and thanks, I wish to express my appreciation of the privilege of once more having enjoyed the hospitality of so many of the American people and of observing their spirit and resolution in the present troublesome times.

Yours sincerely,

W. G. Sutton.

Era Subscriber for 33 Years

Buenos Aires, Argentina.

Dear Editor: In the Reclamation Era of January 1951, page 23, you give notice of an Era subscriber for 34 years, and that you will be interested in hearing from other long time subscribers.

I am somewhat younger. I am an Era subscriber for 33 years starting in January 1918, but from outside of the United States, from Argentina. This may be a record.

Why have I kept my subscription? During my career, as assistant hydraulic engineer, chief engineer, chief of the Irrigation Dept. of Argentina, University professor and actually consulting engineer, I have always found in the Era, useful information for my successive jobs. That is all.

Yours sincerely;

Rodolfo E. Ballester.

We are glad to hear from our neighbors in South America, and especially a long-term subscriber of such good standing. Let us hear from more of our friends.—Ed.

Deep Is the Heart of Texas

From R. F. Travis, who has a farm at Ysleta, Tex., comes this note (along with his check for a two-year renewal): "Thanks for the important information contained in the Era—we greatly appreciate it."

Kansas Comments

Webster, Kans.
March 1st, 1951

We wish to thank you, whole heartedly, for the marked copy of the Reclamation Era, also for the compliments extended by the Bureau of Reclamation which we received in our mail today . . . we only hope to see and enjoy in the not far off future, the benefits of our Kansas projects that are being considered here in this central part of Kansas, where, water heretofore, at times, has really spelled, "Existence."

Very truly yours,

Mr. and Mrs. Curtis Fry.

More Drinking Water

412 Kiesel Building,
Ogden, Utah.

We were considerably interested in the article appearing in the January Era regarding the construction of a Drinking Water system for the Lewiston Orchards project.

It may not be generally known but for 8 years water of the Ogden River project has been utilized for drinking purposes for the government housing project just south of Ogden and known as "Washington Terrace." This project has a population of 6,000 and is a part of the South Ogden Conservation District, one of our subscribing units.

The water is purified by a plant constructed by the housing project and is operated only in the summer time. For the balance of the year the Terrace is supplied with water by the City of South Ogden.

Very truly yours,

Arlie S. Campbell,
Assistant Secretary.

We are most grateful to the Ogden River Water Users Association for this communication, and hope they will correspond with their magazine more frequently. The Ogden River Water Users have a right to feel proud of their project. In addition to supplying drinking water, this project also provides a supplemental water supply to the irrigation farms. Let us hear from more of our projects. We greatly appreciate your interest.—Ed.

RELEASES

Special Issue of La Houille Blanche on the Genissiat Dam

Assistant Director, F. Revol, of Grenoble, France, has sent us a communication regarding a special issue of La Houille Blanche, Revue De L'Ingeniur Hydrualicien, which is devoted entirely to discussions of the Genissiat dam and power plant, described as a masterpiece of the French technique. The announcement or *priere d'inserer* which accompanied this letter states that La Houille Blanche published this specially dedicated issue in cooperation with the National Company of the Rhone. The volume contains 296 pages, 225 illustrations, and constitutes a complete monograph on the project planning, civil engineering, equipment, hydro-electric problems and the present operations and future development of the Genissiat project, compiled by such eminent engineers as M. Henry, M. Gignoux, M. Mathian, M. G. Gres, M. Ch. Chagnaud, M. H. Escalon, M. H. Diserens, M. A. Robert, M. G. Ferrand, M. L. Armanet, M. H. Gerodolle, M. F. Mussard and M. P. Delattre. The publication is written in French and can be ordered from La Houille, Blanche, Postal Box 41, Grenoble, Isere, France. Paper backed copies are 1,400 francs, bound copies, 2,100 francs.

More Wells Used in Utah

A phenomenal increase in irrigation by wells in Escalante Valley in southwestern Utah, which has resulted in pumping a part of the valley beyond the rate of replenishment has been reported in a Geological Survey report released in March 1951 by the Department of the Interior.

Since World War II more than 170 new irrigation wells have been drilled in the valley, and pumpage from wells increased from 24,000 acre-feet in 1945 to more than 80,000 in 1950. The greatest increase in irrigated acreage has been in the southern part of the valley near the town of Enterprise where about 52,000 acre-feet of water was pumped in 1950.

By 1950 the pumpage from wells in the Beryl-Enterprise area was far greater than the natural replenishment to the ground-water reservoir, and water levels in some irrigation wells were being lowered more than 2 feet a year.

The ground-water reservoir still holds a vast amount of water in accumulated storage, and present rates of pumping could be continued for several decades before the ground-water reservoir would be emptied. However, the water must be pumped from progressively greater depths and therefore at increasing cost over the years.

Although pumpage in excess of replenishment is a new development in Escalante Valley, wells have been used here for irrigation for more than 30 years. The recharge was evidently adequate to sustain the draft prior to 1945, except in the 1931–35 drought. In addition considerable ground water has been discharged each year by evaporation and transpiration in the lower parts of the valley, where the water table is at shallow depth. This natural waste of water is still continuing at a rate of several thousand acre-feet a year.

These are some of the findings in an investigation of the ground-water resources of Escalante Valley, undertaken by the Geological Survey in cooperation with the Utah State Engineer. A progress report of this investigation, entitled "Ground water in Escalante Valley, Beaver, Iron, and Washington Counties, Utah," has just been published as part of the State Engineer's twenty-seventh biennial report. Copies can be obtained by writing to the State Engineer, 401 State Capitol Building, Salt Lake City, Utah. ●

Ground Water in Baker Valley, Oreg.

Ground water in ample supply for much additional irrigation development is available at shallow depth in Baker Valley, Baker County, Oreg.

This information is given in a Geological Survey report, released in March by the Department of the Interior, describing the water-bearing strata in Baker Valley, the chemical character of the ground water, the annual fluctuation of the water levels, and the types and yields of the wells.

The report gives the findings of an investigation of ground-water resources made during 1946–49 by the Geological Survey in cooperation with the Bureau of Reclamation and the Oregon State Engineer. It places special emphasis upon the quality of the water in relation to its usefulness for various purposes, and presents 108 complete analyses of ground and surface waters made by the Bureau of Reclamation.

Copies of the report, entitled "Ground-water resources of Baker Valley, Baker County, Oreg.," by Frederick D. Trauger, may be consulted at the offices of the Geological Survey at Room 2209, General Services Building, Washington, D. C., and Room 623, Post Office Building, Portland, Oreg.; at the office of the Oregon State Engineer, Salem, Oreg.; at the district office of the Bureau of Reclamation, Walla Walla, Wash.; and at the public library in Baker, Oreg. ●

POSTSCRIPTS

Shasta and Keswick Reach New High in Production

Record power production at Shasta and Keswick power plants during the month of December swelled the Central Valley Project's return to the U. S. Treasury by more than one million dollars. The two plants produced a total of 303,609,000 kilowatt-hours of electric energy, or three times the amount required by the city of San Francisco during an average 30-day period.

Income Tops Outgo

Rough estimates of seven Bureau of Reclamation project areas show that residents of farms and adjacent towns, whose livelihood is directly dependent on Federal reclamation projects, paid personal income taxes of $57 million in 1949. Their cumulative income tax payments since 1916 total $384 million. The cost of developing these seven projects was $163 million—two and one-third times less than the income tax from the area.

Power Sale Hits New High

Income from sale of power in the 1950 fiscal year hit an all-time high of $33,200,000. A total of 19,790,000,000 kilowatt-hours of hydroelectric power was sold. Despite this record, the demand for power soars far ahead of the Bureau's ability to meet the need. ●

CORRECTION

Wade M. Taylor, recently appointed Regional Power Manager for the Bureau of Reclamation's Region 3, received his Bachelor of Science and Master of Science degrees in Electrical Engineering at the University of Colorado, not at Purdue, as stated in error on page 60 of the March 1951 issue. Mr. Taylor took his freshman year at Purdue University and then transferred to the University of Colorado where he received his B. S. in 1934 and his M. S. in 1935. The University of Colorado is justifiably proud of Wade M. Taylor and Mrs. Taylor, both of whom received their engineering degrees from that University. ●

Getting the Credits Straight

On page 71 of the April 1951 issue of the Reclamation Era, the photos illustrating the article nominating W. G. Sloan—Co-Author of the Missouri River Basin Plan—were all incorrectly credited to Norton T. Novitt, Region 7 photographer, who should have been credited only for the photo of Sloan, Senator Butler and Commissioner Straus at the Trenton Dam dedication. The photo of W. G. Sloan and Major General Lewis A. Pick was taken by T. R. Broderick, photographer for Region 6; and the photo of Assistant Secretary of Interior William E. Warne reading a citation as Governor Val Peterson of Nebraska pinned a Gold Medal on Sloan was taken by District Photographer Friend Slote of the Bureau's Grand Island, Nebr., office. ●

NOTES FOR CONTRACTORS

Contract Awarded During March 1951

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DS-3252	Rio Grande, N. Mex-Tex	March 8	1 7,500-kilovolt-ampere transformer with three 34,500-volt lightning arresters, 1 46,000-volt disconnecting fuse, and 2 current and 2 potential transformers for Willard substation, schedules 1, 6, and 8.	Westinghouse Electric Corp., Denver, Colo.	$87, 83
DS-3252	do	do	2 34,500-volt circuit breakers for Willard substation, schedule 3	Pacific Electric Mfg. Corp., San Francisco, Calif.	16, 75
DS-3257	Columbia Basin, Wash	March 12	2 43,000-kilovolt-ampere transformers for Grand Coulee power plant.	Westinghouse Electric Corp., Denver, Colo.	264, 17
DC-3272	Colorado-Big Thompson, Colo.	March 1	Construction of system dispatchers' building at Flatiron, schedule 1.	Ring Construction Co., Colorado Springs, Colo.	248, 35
DS-3273	Central Valley, Calif	March 8	10 vertical-shaft pumping units for pumping plants on laterals 124.5E, 127.7E, 130.4E, unit 3, Southern San Joaquin municipal utility district, Friant-Kern canal distribution system, schedule 2.	Berkeley Pump Co., Berkeley, Calif.	13, 12
DC-3278	Missouri River Basin, Nebr.-Kansas.	March 5	Construction of earthwork and structures for Superior lateral system, sublaterals drains, and channel changes.	Tom Hellander Co., Fargo, N. Dak.	234, 54
DC-3279	Colorado-Big Thompson, Colo.	March 20	Furnishing and installing one 35,000-kilovolt-ampere vertical-shaft generator (second unit) for Flatiron power plant.	Westinghouse Electric Corp., Denver, Colo.	348, 37
DC-3282	Hungry Horse, Mont	March 13	Completion of Hungry Horse Dam, power plant, and switchyard.	Grafe-Shirley-Lane Co., Los Angeles, Calif.	1, 792, 78
DC-3283	Central Valley, Calif	March 14	Constructing foundations, erecting steel towers, and stringing conductor and overhead ground wires for the replacement of wood-pole sections with steel tower lines on 230-kilovolt Shasta-Tracy Nos. 1 and 2 transmission lines.	Erickson, Phillips & Weisberg, Oakland, Calif.	90, 67
DC-3284	Boulder Canyon, Ariz.-Calif.-Nev.	March 19	Construction of earthwork, pipelines, and structures for lateral 94.2 and sublaterals, part 1 of unit 9, Coachella Valley distribution system, All-American Canal System.	R. V. Lloyd and Co., Coachella, Calif.	343, 10
DS-3286	Fort Peck, Mont	March 13	4 carrier-current telephone transmitter-receiver sets, 6 carrier line tuning units 2 115,000-volt and 2 161,000-volt coupling capacitors, and 6 carrier-current line traps for Fort Peck power plant, and Havre, Shelby, and Great Falls substations, schedules 1, 2, and 3.	General Electric Co., Denver, Colo.	20, 87
DC-3288	Missouri River Basin, Colo	March 8	Construction of an earth embankment test section at Bonny Dam.	Northwestern Engineering Co., Denver, Colo.	82, 89
DC-3289	Kendrick, Wyo	March 27	Installing overhead ground wires on 141 miles of Seminole-Cheyenne 115-kilovolt transmission line.	Trans-Electric Co., Louisville, Ky.	111, 71
DS-3290	Colorado-Big Thompson, Colo.	March 6	4 3-foot by 6-foot 6-inch high-pressure gates with 4 85,000-pound hydraulic hoists and 4 conduit linings for outlet works at Willow Creek Dam.	Northwest Marine Iron Works, Portland, Oreg.	49, 58
DS-3298	Central Valley, Calif	do	5 traveling water screens for laterals 124.5E, 127.7E, and 130.4E, Southern San Joaquin municipal utility district, unit 3, Friant-Kern canal distribution system.	Link-Belt Co., San Francisco, Calif.	42, 72
DS-3299	Rio Grande, N. Mex	March 22	1 115,000-volt circuit breaker for Elephant Butte switchyard, schedule 1.	Pacific Electric Mfg. Corp., San Francisco, Calif.	25, 62
DS-3301	Colorado-Big Thompson, Colo.	do	One 100-ton gantry crane with 20-ton auxiliary hoist for Flatiron power and pumping plant.	Pacific Coast Engineering Co., Alameda, Calif.	129, 45
DC-3302	do	March 19	Construction of 36 miles of Flatiron-Fort Collins-Cheyenne tap 115-kilovolt transmission line.	Trans-Electric Co., Louisville, Ky.	389, 65
DC-3303	Gila, Ariz	March 29	Furnishing and installing 2 12-foot by 15-foot 3-inch, two 10-foot by 5-foot, 1 10-foot 8-inch by 6-foot 6-inch, and 1 12-foot 8-inch by 6-foot 6-inch radial gates; and 2 10,000-pound and 4 float-operated radial-gate hoists for Wellton-Mohawk canal.	Western Contracting Corp., Los Banos, Calif.	59, 90
DC-3308	Rio Grande, N. Mex	March 8	Construction of 13,000/16,250-kilovolt-ampere Albuquerque substation.	Reynolds Electrical & Engineering Co., Inc., El Paso, Tex.	62, 43
DC-3309	Central Valley, Calif	March 20	Furnishing and installing the heating, ventilating, and air-conditioning system for lower vista house at Shasta Dam.	Western Heating & Air Conditioning, Glendale, Calif.	14, 39
DC-3314	Colorado-Big Thompson, Colo.	March 27	Construction of 59 miles of Salida-Gunnison 115-kilovolt transmission line.	Trans-Electric Co., Louisville, Ky.	821, 49
DS-3317	Cachuma, Calif	March 19	Chlorination equipment for Tecolote tunnel and Lauro chlorination and control houses South Coast conduit, Goleta section.	Wallace & Tiernan Sales Corp., Belleville, N. J.	40, 69
DS-3324	Colorado-Big Thompson, Colo.	March 29	2 vertical-shaft centrifugal pumps for Willow Creek pumping plant.	Worthington Pump & Machinery Corp., Harrison, N. J.	154, 00
100C-116	Palisades, Idaho	March 23	Furnishing and erecting 140,000-gallon water tank for Palisades camp, schedule 2.	Chicago Bridge & Iron Co., Salt Lake City, Utah.	21, 99
200C-148	Central Valley, Calif	March 6	Installing and painting miscellaneous metalwork at Shasta Dam, schedule 1.	Wiscombe Painting & Decorating Co., Salt Lake City, Utah.	31, 36
200C-148	do	March 7	Installing and painting miscellaneous metalwork at Shasta Dam, schedule 2.	R. A. Neuman & Sons, McMinnville, Oreg.	18, 62
300C-15	Davis Dam, Ariz.-Nev	March 8	Construction of warehouse and fencing for Prescott substation.	Jost Construction Co., Prescott, Ariz.	20, 93
300C-19	do	March 1	Construction of 12.5-kilovolt structure for Coolidge substation	Newberry Electric Corp. of Arizona, Phoenix, Ariz.	12, 63
300C-13	Boulder Canyon, Ariz.-Calif.-Nev.	March 2	Constructing shop building at Boulder City, Nev	Lembke Construction Co., Las Vegas, Nev.	68, 15
600C-54	Missouri River Basin, Mont	March 15	Construction of warehouse and fence for Canyon Ferry Dam and power plant.	Otis Williams & Co., Helena, Mont.	20, 27
703C-171	Missouri River Basin, Wyo	March 26	Erecting prefabricated garage and machine shop at Reclamation Center near Casper, Wyo.	Long Construction Co., Inc., Billings, Mont.	39, 24
703C-175	North Platte, Wyo	March 21	Rehabilitation of existing laterals, Fort Laramie Canal	Harry F. Berggren & Sons, Inc., Scottsbluff, Nebr.	78, 29
704S-168	Colorado-Big Thompson, Colo.	March 20	Station service switchgear, transformer and voltage-regulator assembly for system dispatchers' building at Flatiron.	Westinghouse Electric Corp. Denver, Colo.	18, 09

Construction and Materials for Which Bids Will Be Requested by July 1951

Project	Description of work or material
achuma, Calif.	Construction of 6,000-foot long, 6-foot diameter, concrete-lined, horseshoe-shaped Sheffield tunnel near Santa Barbara, Calif.
entral Valley, Calif	Construction of 25 miles of concrete and reinforced concrete irrigation pipe lines, 12 to 36 inches in diameter, for the Stone-Corral irrigation district, Friant-Kern canal distribution system, near Seville, Calif.
Do	Construction of 20 miles of concrete and reinforced concrete pipe lines for Unit 1, Exeter irrigation district, Friant-Kern canal distribution system, near Exeter, Calif.
olorado-Big Thompson, Colo.	Construction of 11 miles of partially concrete-lined St. Vrain supply canal, 550 cubic-feet-per-second capacity, including a 1,200-foot long concrete siphon and culverts, about 8 miles west of Berthoud, Colo.
Do	Construction of Flatiron section of Horsetooth feeder canal, including 3.5 miles of 930 cubic-feet-per-second capacity concrete-lined canal, a 700-foot tunnel, and 2 siphons about 500 feet in length, 10 miles west of Loveland, Colo.
Do	Installation of a 5,000-kilovolt-ampere transformer bank in Fort Morgan substation.
Do	Construction of sidewalks and curbs, drainage facilities, exterior lighting, and road and parking area surfacing at Granby pumping plant near Granby, Colo.
Do	Painting plaster walls and ceilings at Granby pumping plant.
Do	Alternating-current distribution board, direct-current distribution board, battery charging equipment, motor and heating control boards, lighting transformers, and station service transformers for Flatiron power and pumping plant.
Do	Generator voltage switchgear, 15-kilovolt, for Flatiron power and pumping plant.
Do	Dispatcher's system map board for Flatiron dispatcher office.
Do	Motor and generator neutral grounding equipment for Pole Hill and Flatiron power plants.
olumbia Basin, Wash	Construction of 15.5 miles of unlined Potholes East canal, 1,800 cubic-foot-per-second capacity, and 5 miles of unlined Ringold wasteway, 1,800 cubic-foot-per-second capacity, about 6 miles southeast of Othello, Wash.
Do	Landscaping right switchyard and left abutment at Grand Coulee dam.
klutna, Alaska	Construction of 4.4-mile, 9-foot diameter, concrete-lined Eklutna tunnel and surge tank.
Fort Peck, Mont	Furnishing and erecting 200-foot tower and erecting 4 Government-furnished towers, each 140 feet high, and furnishing and erecting 3 8- by 8-foot prefabricated control buildings.
Hungry Horse, Mont	2 carbon-dioxide fire extinguishing systems for Hungry Horse power plant.
Klamath, Oreg.-Calif	Construction of pumping plants "R" and "S" in N Canal area, second extension, Tule Lake division.
Kendrick, Wyo	Construction of 36 miles of Seminoe Dam-Bairoil 34.5-kilovolt transmission line.
Do	Construction of 30 miles of Sinclair-Hanna 34.5-kilovolt transmission line.
Do	Construction of 35 miles of double-circuit telephone line from new Casper substation to Alcova Dam.
Missouri River Basin, Colo.	Construction of 3,000-kilovolt-ampere Julesburg substation.
Missouri River Basin, Mont.	Construction of Canyon Ferry-East Helena 115-kilovolt transmission line consisting of 2 parallel lines each 8 miles long.
Missouri River Basin, Nebr.	Construction of Ogallala substation, including constructing foundations, erecting structural steel, and installing electrical equipment. The substation has one 7,500-kilovolt-ampere transformer, 1 115-kilovolt bay, and 3 34.5-kilovolt bays.
Do	Construction of Chadron substation, including foundations, erecting structural steel, and installing all electrical equipment. The substation has 3 3,333-kilovolt-ampere transformers, 1 115-kilovolt bay, and 2 34.5-kilovolt bays.
Missouri River Basin, S. Dak.	Construction of 135 miles of 230-kilovolt steel tower transmission line between Oahe damsite and Fort Randall power plant.
Missouri River Basin, Wyo.	Construction of 15,000-kilovolt-ampere Lovell substation.
Do	Construction of 2,000 feet of Alcova switchyard road about 32 miles southwest of Casper, Wyo.
Do	Furnishing and erecting 16 miles of four-wire telephone line from Moorcroft, Wyo., to site of Keyhole Dam.
Do	Main control board, distribution boards, and battery charger for Lovell substation.
Shoshone, Wyo	Construction of Willwood canal crossing of the C.J. Coulee near Cody, Wyo., by the use of a bench flume on an earth dike or by use of a monolithic concrete siphon.
Yakima, Wash	Rehabilitation of Bumping Lake Dam outlet structure and tower near Yakima, Wash.
Do	Rehabilitation of Kachess Dam outlet works channel near Easton, Wash.

United States Department of the Interior
Oscar L. Chapman, Secretary
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Washington Office: United States Department of the Interior, Bureau of Reclamation, Washington 25, D. C.

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1951

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Ruth F. Sadler, *Editor*

Subscription rate $1 a year for persons residing in the United States and Canada; $1.50 a year for foreign subscriptions; special rate of 50 cents a year for members of water users' associations, and Bureau of Reclamation employees.

OUR FRONT COVER

Being an orphan is not so bad if you have "Bummer's" luck. Found out in the cold on the Watenpaugh farm he wound up adopted in the capable hands of Miss Mary Jean Watenpaugh of Meridian, Idaho, who happens to be the sister of Lee Watenpaugh, whose prize-winning essay appears on page 122 of this issue. *Photo by Phil Merritt, Region 1 photographer.*

30 YEARS AGO IN THE ERA

EMANCIPATION

(Inspired by the Newlands National Irrigation Act June 17, 1902)

The Nation reaches its hand into the Desert,

And lo! private monopoly in water and in land is scourged from that holiest of temples—the place where men labor and build their homes!

The Nation reaches its hand into the Desert.

The wasting floods stand back, the streams obey their master, and the stricken forests spring to life again upon the forsaken mountains!

The Nation reaches its hand into the Desert.

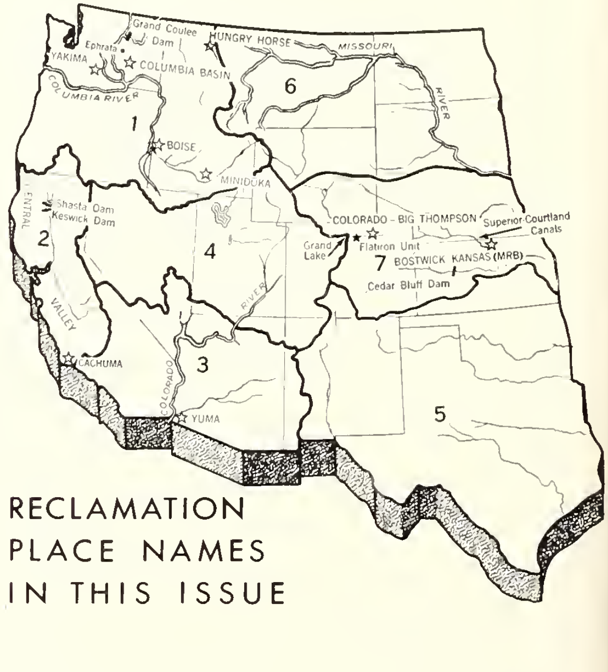
The barred doors of the sleeping empire are flung wide open to the eager and the willing, that they may enter in and claim their heritage!

The Nation reaches its hand into the Desert.

That which lay beyond the grasp of the individual yields to the hand of Associated Man. Great is the Achievement—greater the Prophecy!

From "Conquest of Arid America," 1905 Edition, by Wm. E. Smythe.

(Reprinted from the June 1921 issue of the RECLAMATION RECORD, predecessor to the RECLAMATION ERA.)



RECLAMATION PLACE NAMES IN THIS ISSUE

new twist on sediment

by E. J. CARLSON,
Engineer,
Branch of Design and
Construction,
Denver, Colo.

INTERNATIONAL PARTNERSHIP made possible the construction of these curved divide walls at the Superior-Courtland Dam and canals. Far-off India helped solve the problem of diverting and keeping the canal clean. *Photo by R. Boyce, Region 7.*

From the Bureau's research laboratories in Denver comes the good news of the latest successful effort to curb one of the water users' stealthiest enemies—sediment.

The new development is based on the laboratory-tested technique called curve principle of diversion. It has been adapted in the design of the headworks for the Superior and Courtland Canals which start at the Superior-Courtland Diversion Dam. The dam is a brand new feature of the Missouri River Basin project on the Republican River near Guide Rock, Nebr.

Here is the background on the research development of the curve principle and its application—the new twist on sediment.

When the preliminary designs for the Superior-Courtland Diversion Dam were being studied, engineering brows were furrowed in concern over the large concentration of sediment that will be carried by the Republican River to the dam. This load of river-bed material could then be drawn into the headworks of the Superior and Courtland Canals which flank the upstream side of the diversion structure. From available data on the river's sediment concentration, the engineers learned that the bed load averaged about two-tenths of 1 percent of the water discharge during the years from 1943 to 1946. Applying this percentage to the water requirements for irrigated lands to be served under these canals, they then deduced that should this same sediment-laden water enter the headworks without hindrance, the bed-load material deposited would amount to about 170,000 cubic yards each year.

Definitely a headache for the Bureau's sedimentation specialists and a whopping potential backache for the shovel-wielding irrigation farmer!

The engineers of the Denver hydraulic laboratory were then consulted and asked to assist in recommending a design which would reduce the amount of coarse sediment transported through the headworks of the canals.

The hydraulic research engineers reasoned that the best plan of attack was to keep the sediment in the Republican River and out of the Superior and Courtland Canals—which at first appears as a truism, but which in actual practice was easier said than done. True, the famed desilting works at the Imperial Diversion Dam on the Colorado River operate successfully in keeping sediment out of the All-American Canal, but the cost of constructing a similar desilting scheme for the Superior-Courtland diversion was prohibitive.

In their review of existing works the engineers' attention turned abroad to the several successful sediment control schemes for diversion dams developed by the Government of India. These con-

trol schemes consist of divide walls which split the stream of water, allowing clear water to run into the canal headworks and diverting the sediment-laden water downstream. Although the Indian rivers and divide walls are much larger than the Superior-Courtland diversion, the principles evolved and practiced applied substantially to the Republican River undertaking. Accordingly, from these studies of the Indian Government's developments came the specific approach to the hydraulic model studies on the Superior-Courtland Dam.

A model of the diversion dam one-fifteenth in size to the full-size structure was constructed in the laboratory, and experiments were begun on models of various types of divide walls. The goal constantly before the engineers was to develop a method of diverting as much of the sediment downstream and at the same time arrive at a solution which would be within reasonable cost limits to the project.

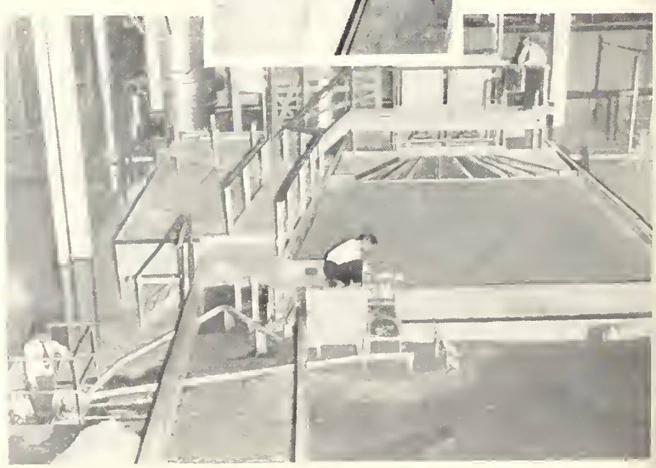
To keep the model as large as possible and thereby assure the greatest similarity between the model and prototype (full-size structure), one-half of the model diversion dam was tested at one time. The right half of the dam, which includes the Courtland headworks and sluiceway, was tested first. Experiments were then conducted on the left half, comprising the Superior headworks and sluiceway.

Sediment was fed in the model basin constructed upstream from the diversion dam, at a rate which would duplicate the concentration of sand in the water of the Republican River. An electric vibrator type of apparatus was used to allow an even flow of sand to be dispersed in the water from the supply hopper. A system of sampling the discharge of water and sediment in both the headworks and sluiceways was also perfected so that the rate and volume of sediment entering the headworks of the canals could be detected immediately. The apparatus devised indicated the concentration of sediment in each of the samples taken from the headworks and the sluiceway. Comparison of these concentrations for each scheme soon revealed the particular arrangement which would allow the least amount of sediment to enter the headworks.

First tests conducted were those on the headworks and sluiceways without the addition of divide walls. Then various modifications were tried out on the model and were subject to exhaustive study. Without the divide walls, the tests disclosed that a higher concentration of sand entered the headworks of the canals than the concentration going through the sluiceways and into the river below. Conversely, by adding the divide walls, the concentration of sediment entering the sluiceways was much greater than in the headworks.

These tests clearly showed the advantage of di-

RECEDING FLOOD on Republican River (below) shows curved steel sheet piling wall at Superior headworks. Right, silt bed in model of Courtland Canal. Below, E. J. Carlson (center) adjusting sluice gate on model of Courtland headworks, O. S. Hanson (right) regulating sand feed into dam as R. S. Brown (left) checks sediment samples. ***Two photos at right by G. F. Breitung, Branch of Design & Construction, Denver, Colo. Photo below by R. Boyce, Bureau of Reclamation.***



vide walls in diverting coarse sediment from the canals' headworks. From this clear-cut picture of sediment action, the laboratory hydraulicians constructed models of two curved divide walls. One wall extended upstream between the dam and the Superior headworks; the other was placed athwart the Courtland headworks. Thus the curve principle of sediment division was evolved and adapted.

Stated simply, the principle is based on this fact: If water is twisted or channeled around a curve, the sediment moving on or near the bed tends to move to the inside of the curve and is diverted back into the river below the dam.

On the basis of this laboratory work, two curved walls of steel sheet piling were subsequently driven upstream from the Superior-Courtland Diversion Dam. The wall protecting the Superior Canal headworks is about 50 feet long; the wall for the Courtland Canal headworks is over 100 feet long. Both walls are topped by a continuous concrete cap 10 inches thick.

By installation of these comparatively minor additions to the diversion structure the relatively sediment-free portion of the stream flow is channelled into the canals. Water carrying about two-thirds of the sediment is twisted away from the headworks and is carried away into the river.

The research engineers look upon the curved walls as a step forward in licking the knotty sediment problem on Reclamation projects. In the past, water users have grudgingly accepted sediment as a necessary evil. However, the curve diversion walls appear as the most promising of several solutions in minimizing the influx of this elusive element into irrigation facilities.

To the water users who will benefit by the new Superior-Courtland Diversion Dam, the curved guide walls may be the answer to the endless cost and effort in dredging thousands of yards of sediment that choke canals and laterals. THE END.

FIRST KANSAS DAM COMPLETED UNDER MISSOURI RIVER BASIN PLAN

CEDAR BLUFF DAM, on the Smoky River in Kansas, begun on April 1, 1949, is to be dedicated June 10, 1951. This multiple-purpose dam, combining flood control and irrigation features, will work in conjunction with Kanopolis Dam, also on the Smoky Hill River near Salida, Kans. An irrigation district is now in the process of being formed on the irrigable land just below Cedar Bluff Dam. It is the first dam to be completed in Kansas under the Missouri River Basin project plan, and is one of several dams proposed for control of flood waters in the Kansas River Basin. Other dams in the Kansas River Basin now completed, or near completion, include Bonny Dam in Colorado, Medicine Creek, Trenton and Enders Dams in Nebraska (all built by the Bureau of Reclamation), and Harlan County Dam, near Republican City, Nebr., being built by the Corps of Engineers. Among the dignitaries to attend the dedication are Congressman Wint Smith of Kansas, President of the National Reclamation Association Harry Polk, and Commissioner of Reclamation Michael W. Straus. *Photo by N. T. Novitt, Region 7 photographer.*

Work Started on Big Thompson Weatherproof Power Lines

During the next 14 months the Trans-Electric Co. of Louisville, Ky., will be constructing one of the country's toughest power transmission lines, on the 59-mile route over the Continental Divide between Gunnison and Salida, Colo., as part of the Colorado-Big Thompson project.

The contractors, who received the award in late March and were to start work within a month, will string the 115-kilovolt, aluminum, steel-reinforced cable over some of the most rugged terrain in the United States. The line will begin at a point about 5 miles west of the city of Salida, and the contractors will use as many as 1,000 wood poles, from 50 to 75 feet high to support the aluminum lines. A 24-mile stretch crosses Monarch Pass (11,312 feet high) and while constructing this portion of the line the crews will be working at altitudes of 8,500 feet and higher. Four miles of this section will get special bracing, designed to hold up under 1¼ inches of ice, 60-mile-an-hour gales, and 20°-below-zero temperatures. When the line is completed it will carry low-cost Colorado-Big Thompson project electricity to the city of Gunnison, REA cooperatives, and other preference customers in the area through wheeling arrangements with the Public Service Co. of Colorado. •

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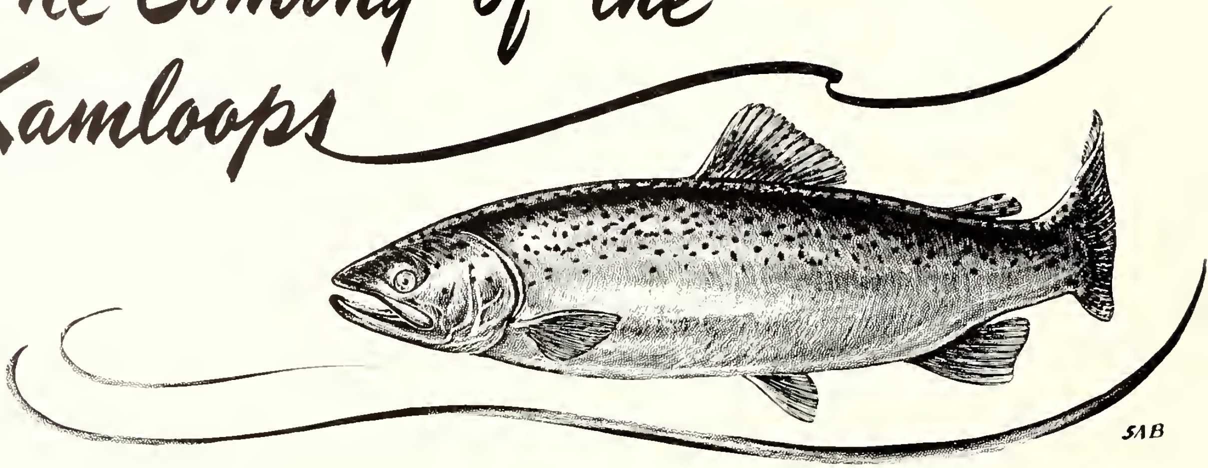
The Coming of the Kamloops



by T. B. GIBSON, Public Activities Officer, Shasta Dam, Region 2 (headquarters at Sacramento, Calif.)

Melvin Kenyon of Central Valley landed a 16-inch fish just above Shasta Dam. He measured it, released it and reported the event to Henry Clineschmidt, of Redding, Calif.

The fish was a "kamloops"—a variety of rainbow trout transplanted from Canada to California by a group of sportsmen who saw the tremendous recreational possibilities of Shasta Lake. This group, headed by the aforementioned Henry Clineschmidt, calls itself California Kamloops, Inc., and has taken over the job of obtaining, rearing, and planting kamloops in Shasta Lake. The organization also does a great deal to encourage sport fishing in northern California.

Why did they select the kamloops? This fish, if properly fed, and in the proper environment, grows to a tremendous size, and furnishes the ultimate in fresh water fishing. The kamloops originated in Meadow Creek, a tributary of the Frazier River in British Columbia, where officials of the Fish and Game Department know of at least one record size kamloops taken in Jewel Lake—the fish weighed 52½ pounds, and probably measured from 3 to 4 feet in length.

No such size has yet been attained by the transplanted kamloops in Shasta. After all, some of them are less than 2 years old. The largest reported so far was a 22-incher taken at the Pit River Bridge this January. Mr. Clineschmidt is emphatic in stating that this program is experimental, and the organization does not expect any great amount of "large fish" sport fishing until 1956. The immediate future should not produce anything other than spotty "samples" of fishing to come, and all fisherman are cooperating by reporting their catches, measuring and releasing the fish into the lake to grow to even larger size. All of the kamloops caught so far have been taken by people fishing for large mouth bass.

Shasta Lake is an ideal spot for the kamloops trout which thrive in deep fresh water lakes. These fish can only grow where the water is quite deep and consistently cold. The few kamloops which have already been planted in the clear, cold waters of Shasta Lake, which is usually over 450 deep at the dam, appear to enjoy their new home.

In June 1949, California Kamloops, Inc., purchased 2,119 kamloops eggs from the British Columbia Fish and Game Department. These eggs were hatched at the United States Fish and Wildlife Service's Coleman Station Hatchery on Battle Creek. The fry were held and fed until they were 1 year old. In June 1950, with the permission of the California Fish and Game Commission, 1,319 kamloops up to 11 inches in length were planted in the main waters of Shasta Lake.

At the same time, another shipment of eggs (purchased by California Kamloops, Inc.), was received from British Columbia. A little over a fourth of these fish were hatched—26,994 out of 100,000. This low ratio of hatched eggs was due to the very advanced stage of the eggs when re-

ceived. However, this second lot is now being kept and fed at Coleman Station. When they are 1 year old, in June 1951, they will join the first-comers in Shasta Lake.

Besides clear, cold, deep water, the kamloops requires certain food in sufficient quantities if it is to reach maximum size. In November 1950, about 6 months after the first kamloops had been placed in Shasta Lake, California Kamloops, Inc. imported 226,800 kokanee salmon eggs. The kokanee is a variety of land-locked salmon which grows fast, and provides a fine source of food for the kamloops. In January 1951, 200,000 kokanees, which had been hatched and raised at Coleman Station Hatchery, were planted in the tributaries of Shasta Lake: Slate Creek, Dog Creek, Salt Creek, Big Backbone Creek, Squaw Creek, and headwaters of the McCloud river. Unlike the kamloops, kokanees are held only for about 60 to 75 days, at which time they are about $1\frac{1}{4}$ inches long.

California Kamloops, Inc., plans to procure 300,000 kamloops eggs and twice as many kokanee eggs (600,000) per year for the next 5 years. The kamloops will be hatched and held until they are yearlings. The kokanees will be hatched and held until they are 2 to $2\frac{1}{2}$ months old and then will be planted.

To do this job, California Kamloops, Inc., estimates their operating expenses at about $3,000 per year. This will cover the cost of eggs, shipping, medicine, and feed. Feed money is to be paid to the Fish and Wildlife Service. In the past the Fish and Wildlife Service has "boarded" the kamloops free of charge as a gesture of good will toward western sportsmen. But due to the great number of fish to be reared in the future, it has become necessary to make other arrangements.

The Shasta County Board of Supervisors has agreed to appropriate $1,000 each year from Fish and Game fine money for this venture. The Butte County Board of Supervisors has agreed to appropriate $500 each year from the same source, and Redding sportsmen have offered $500 each year to help defray the expenses. The remaining money needed to operate will be raised by selling memberships in this nonprofit organization at $1 per year throughout the West.

Shasta Lake, now the cradle of one-time Canadian kamloops, should have some mighty fine fishing by 1956, and the story of this local-State-Federal cooperation in a project to improve what are called "recreational benefits" and "fish and wildlife propagation and conservation" is an illustration of what we mean by "multiple purpose" reclamation structures in the West. THE END.

IMPORTANT NOTICE!

Beginning with the July 1951 issue, the price of the RECLAMATION ERA will be raised to $1.50 for regular subscriptions, with a special rate of $1 for water users and Bureau of Reclamation employees. Subscriptions for persons residing outside the United States and Canada will be $2 a year. Renewals and subscriptions postmarked up to and including June 30, 1951, will be honored at the present rate of 50 cents for water users and Bureau employees, $1 for regular subscribers, and $1.50 for foreign subscriptions. Those postmarked July 1, 1951, and thereafter will be at the new rate.

We regret the necessity for raising the rate, due to production costs, which have increased despite many economy measures taken to reduce expenditures as much as possible and maintain the 40-year-old standards set by the Bureau of Reclamation's official monthly periodical.

INGERLINGS WEIGH IN—An employee of the Coleman Hatchery f the Fish and Wildlife Service near Shasta Dam weighing and ounting fingerlings prior to planting kamloops in Shasta Lake. *hotograph by J. E. Fluharty,* Region 2.

ROYAL PALACE in Bangkok is scene of leavetaking as Commissioner Straus shakes hands with Prime Minister Field Marshal Pibul Songgram of Thailand. At right is M. L. X. Khambu, Director-General of the Royal Siam Irrigation Department, a former Reclamation trainee.

RICE RAFTS made of teakwood float right over the spillway of this diversion dam on the Me Ping River in northern Siam. This is part of the Me Fact project, 16 years old, serving about 40,000 acres, and providing much of Siam's most important crop—rice, plus many other substantial benefits.

RECLAMATION STREET—26,000 Miles Long

PART 2—FROM INDIA TO THE UNITED STATES

by MICHAEL W. STRAUS, Commissioner, Bureau of Reclamation

India has 350 million people—more than twice as many as the United States, living on an area less than half as large. It has enormous water supplies, only 6 percent of which are utilized; plenty of tillable land; and an almost inexhaustible supply of labor. Because of past failures to develop water and power resources, its living standard is one of the lowest in the world; and the newly independent government is now seeking literally with the hands and muscles of its people to build the engineering works it needs.

India has been practicing irrigation for centuries, and it has more irrigated land than any other nation. It has some of the longest and most impressive irrigation canals on earth, and certain of its irrigation and silt-handling measures are superior to those in any other nation. Nevertheless, present irrigation is only a fraction of what is needed. Power developments lag still further behind. India has only 14 kilowatt-hour consumption per capita, compared with 3,000 kilowatt-hours per capita in America and many European countries, and most of this is confined to the great cities. There is very little coal and practically no oil; so further power development, and, hence, further industrialization, must depend largely upon hydroelectric developments. It is estimated that less than one-eightieth of India's hydro potential has been developed.

The Indians are working now on a tremendous program which cannot be completed for many decades. They are building and planning some of the highest dams in the world. But these projects are being built largely by hand labor. I saw 60,000 laborers, mostly women, working on one canal, each putting a couple of shovelsful of earth in a basket and carrying it away on her head. Concrete mix is carried in the same way, about 4 cubic inches each trip. These laborers are all employed by the Indian Government, which believes that if they are not thus employed, many of them would have to be supported in idleness. The Indian Government prefers to design and construct its own works rather than employ foreign contracting firms under the limited-risk contracts available. Realizing it will probably make many mistakes, the Government argues that only in this way can it learn to build its own developments in the future.

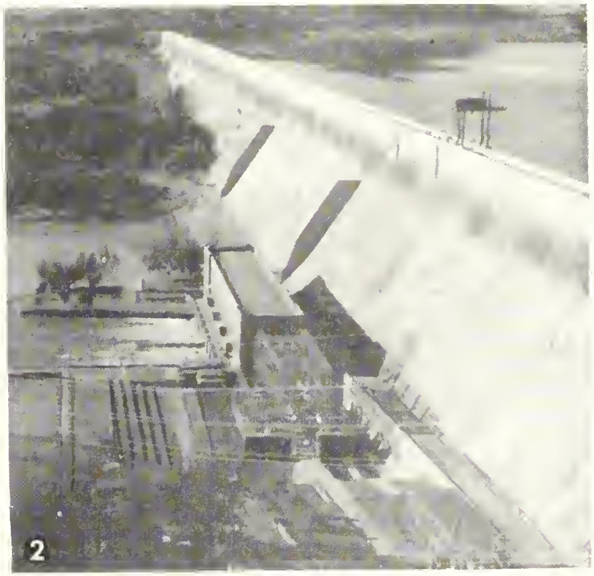
One example of India's many ancient and admirable irrigation developments is the great Ganga Canal, which takes off from the Ganges River by simple diversion works and extends well over a hundred miles. This enormous canal has been

serving for more than a century and makes a major contribution to India's food supplies.

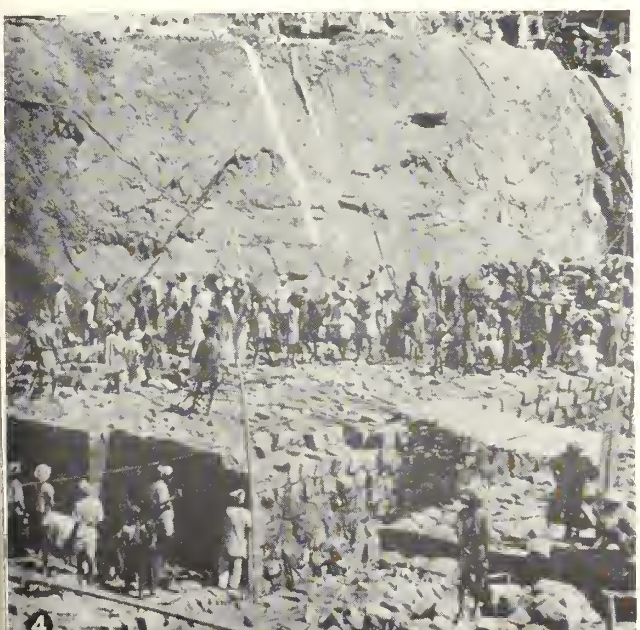
Outstanding among the water and power developments now under construction in India is the Bhakra-Nangal project on the Sutlej River, programed for completion in 1955 or 1956. Here, 680-foot Bhakra Dam, which will be the second highest in the world, only 46 feet lower than Hoover Dam, is being built largely by human muscle power. The project will irrigate 6½ million acres and provide 400,000 kilowatts of generating capacity.

The Damodar Valley Authority, west of Calcutta, is a frank copy of the Tennessee Valley Authority. It includes dams, 1,643 miles of irrigation and navigation canals, power facilities, and an ambitious soil-conservation and resettlement program. One of its features is a 32,000-kilowatt thermopower plant which will help supply energy for India's only big modern steel plant, the Tata works. The DVA will irrigate 967,000 acres, generate 240,000 kilowatts of hydroelectric power, and provide flood control and navigation benefits.

The Mahanadi Valley development is another



INDIA'S A-BUILDING—(1) Rehabilitation necessary here too! Repairing a diversion dam across the Ganges at Hardwar. (2) Hydropower plant 75 miles south of Bangalore. (3) India's "TVA" (known as DVA) placing concrete in foundation of Tilaya Dam. (4) No labor shortage here; hordes of laborers pitching in on massive masonry at Hirakud Dam. ***Photos made from Kodachrome slides taken by Chief Engineer L. N. McClellan of the Bureau of Reclamation.***




NEW DELHI exhibit, above left showing a huge model of India, part of a 40-acre display in connection with the conferences. Outdoor hydraulic research laboratory at Pathankof, Amristar, at right. *Photos adapted from Kodachrome slides taken by Chief Engineer L. N. McClellan.*

great Indian project. Only one of its three major dams is at present under construction; this one, Hirakud Dam, will be nearly 3 miles long and 150 feet high. The project will irrigate about a million acres and will provide 310,000 kilowatts of capacity.

The Tungabhadra project is being built by the two provinces of Madras and Hyderabad. Each province has its own complete crew and administration and builds out from its own side of the river, with every expectation that the dam will join together in the middle. The Madras side of the development will include a 225-mile canal and will irrigate 300,000 acres; the Hyderabad side will have a 140-mile canal and will irrigate 671,000 acres.

One of the vastest water projects ever considered anywhere, the Kistna Pennar project, is being proposed in the State of Madras. It would irrigate more than 3 million acres and develop large blocks of power.

In one area, however, India is making progress backward. Almost 5 million acres of once-productive land in the Punjab—a region which extends into both Pakistan and India—have been ruined by waterlogging and salting. Land is going out of production faster than it can be reclaimed. The main causes are overirrigation and canal seepage. In this region, after irrigation water is put onto the land, production is extremely high for perhaps 10 or 15 years. Then if there is careless irrigation the yields begin to diminish. Soon it is not worth while to harvest, and the land must be abandoned. The government has sunk hundreds of expensive tube wells to pump out the areas to be drained and use the water for further irrigation elsewhere. It is also lining some canals to prevent seepage. However, the Indian system of reducing the payments required for water on lands of poor yield does not encourage the best irrigation practices.

The island of Ceylon, now enjoying national independence, has an area of 25,000 square miles and a population of 7¼ million—that is, an area less than a fourth that of Arizona and a population 10 times as large. Here history brought forth a classic example of an ancient civilization which rose with irrigation and declined when the irrigation development was neglected. Some of the ancient "tanks," or reservoirs, are still functioning. The Minneriya Tank, which serves 11,200 acres that yield two rice crops a year, was built in 900 A. D.; the Parakrama Tank serves 21,000 acres and was built in 1200 A. D., and others have been in continuous use for as long as 1,500 years—which gives some conception of the enduring usefulness of a well-considered irrigation project. However, during dark years of war, conquest, and plague, some of the tanks fell into disuse, and many are still buried in jungle. Now the government is building new, modern irrigation developments.

The west and south sides of the island are well-watered. Here two-thirds of the people are concentrated. Though rice is their chief diet, their principal crops are tea, rubber, and coconut, which they sell on export markets so they may buy imported rice, to supplement the inadequate Ceylon-grown supply. The government wants to open the dry north and east sides of the island, settle them, and grow more rice at home. The Gal-Oya River Dam, being built by an American con-

tracting firm (Morrison Knudsen International) will irrigate 10,000 acres now in jungle, provide supplemental irrigation for 30,000 more acres, and include 10,000 kilowatts of generating capacity. Though the dam and power house are almost complete, the government development board has not yet provided the canals or transmission lines nor finished its arrangements for settling the land. Each new settler will receive three acres of land, a house, and some cattle. He will be asked to repay a portion of the costs of these properties, but none of the cost of the main works of the project.

Mr. Paul von der Lippe, Bureau of Reclamation engineer, has been serving the Ceylonese Government as consultant in planning projects for 3 years. The government needs and would like to have further American help, particularly in project planning phases of its program.

The crown colony of Singapore has some rice irrigation, but inasmuch as military or quasi-military operations against guerrillas are chronic, and the government and the settlement are far from tranquil, there seems little probability of hydroelectric or irrigation development programs in the near future.

Thailand (formerly called Siam) is about four-fifths the size of Texas but has 2½ times as many people. It has never been a colony, and its standard of living is somewhat above that of adjoining South Asian areas. The people live on a rice economy and they need water-resource development for power and navigation as well as for food. To a large extent, the rivers and canals are used as highways.

A number of highly successful irrigation projects are already completed and in operation, and 15 additional major projects are now in planning or construction phases. A World Bank loan of $19 million for constructing the country's first multiple-purpose project on the Chao Phya River has been negotiated. This project is expected to play a part in Siamese economic development comparable to that which the Boulder Canyon project has played in our own western development.

The dry northeastern section of Siam has some poor soils, low-living standards, and much malaria. Here a project is under construction on the Mool (pronounced *moon*) River which will irrigate about 40,000 acres of rice-paddy lands. In higher northern areas, which are generally more prosperous, the Me Fact project on the Me Ping River has been completed for 16 years and is serving some 40,000 acres with definite benefits already apparent.

Projects currently being completed will bring water to irrigate land at a capital cost of about $20 per acre. There is no provision for any repayment by project beneficiaries. The government believes that benefits to the Nation as a whole justify the government's paying all the costs. The Siamese situation is unusual also in that the country has no code of water laws.

The Royal Siamese Irrigation Department is one of the strongest and most independent units of the Thai Government, and 38 of its leading engineers have had trainee courses in America with the Bureau of Reclamation. Still more Thai engineers are in America now or will come in the near future. Under M. L. X. Khambu, Director General of the Irrigation Department, the Nation's water development program is being carried out by government forces without recourse to foreign contractors. Much of the actual work is done by human muscle. The government would like to have more American machinery and access to more American technical knowledge.

Hongkong, the island colony which has almost 2 million people on an area of only 391 square miles, relies on the development of its mountainside to provide domestic water for the city and irrigation water for the land. Every square foot of agricultural land is terraced and frequently irrigated by hand-carried water. Catchments, reservoirs, and canals are of a high order, but the possibilities of extending them are limited.

In the Philippine Islands, a considerable irrigation development alreadys exists and plans for more are being made. However, basic data, both economic and hydrological, are sadly deficient, and project planning hence remains a difficulty. Authority over water and related resources is widely scattered among government agencies. Though the government is not now in a position to obtain American technical aid, such aid will doubtless be needed in order to bring presently broached plans to completion. THE END.

Boke Becomes Member of United Nations Committee

Richard L. Boke, Regional Director, Sacramento, Calif., has become a member of the United

Nations permanent advisory committee on arid zone research. He attended an interim council meeting of the group, which is a unit of the United Nations Educational Scientific and Cultural Organization, in Paris last November, at which time plans for a permanent committee were adopted. The first meeting of the permanent committee was held in Algiers late in March. In addition to attending this meeting, Mr. Boke made a 4-day study tour of Sahara Desert irrigation stations. Jaime Torres-Bodet, Director-General of UNESCO, selected Mr. Boke as an individual on the basis of his long experience with water and soil problems in southwest United States and Latin America, and not as a representative of the Bureau of Reclamation. His term will be for 2 years, and his expenses will be paid by the United Nations. •

Lauro Dam to Serve as Regulator for Santa Barbara

The Bureau of Reclamation on April 5 awarded the contract for construction of the Lauro Dam to Clyde W. Wood, Inc., of North Hollywood, Calif.

The contractor will build a 110-foot-high earth-filled dam, near Santa Barbara, Calif., change the channel for San Roque Creek, relocate Laurel Canyon Road, and clear the reservoir site to provide for 25 acres of surface water. The dam and reservoir will regulate the flow of an additional 10,300 acre-feet of water for the city's municipal system and provide additional water for 29,650 acres of irrigated land in Santa Barbara County. Work on the structure, an important feature of the Bureau's comprehensive Cachuma project in southern California, must begin a month after receipt of notice to proceed and must be completed in 400 days.

The primary purpose of the Cachuma project is to provide additional water to maintain existing irrigation, suburban and urban development and to permit future normal expansion of the city of Santa Barbara, along with Goleta, Montecito, Summerland, and Carpinteria County Water Districts. In the water districts continuous overpumping of underground water has created a hazard of salt-water intrusion to the extent that one-third of the irrigated acres may revert to dry-farmed status.

Construction of the Cachuma project will relieve the critical situation in Santa Barbara where use of city water exceeds the estimated safe yield from the enlarged Gibraltar Reservoir. •

Carr Becomes First Full-Time Congressional Consultant on Reclamation


James K. Carr

Representative John R. Murdock of Arizona, Chairman of the House Committee on Interior and Insular Affairs, has appointed James K. Carr, former Sacramento Valley District Manager in the Bureau of Reclamation's Region 2, as Committee Consultant on Reclamation matters. Congressman Clair Engle of California, Chairman of the Subcommittee on Irrigation and Reclamation commented on the appointment by saying, "We are pleased to obtain the consulting services of Mr. Carr, who is an engineer with a wide background of experience in reclamation work. For the last 15 years he has been an engineer and administrator with the Bureau of Reclamation on California's huge Central Valley project, an outstanding example of diversified reclamation problems."

Carr began his reclamation career with the Bureau on construction work at Shasta Dam in 1936. He later served as Assistant to the Regional Director in Sacramento. In 1945 when he became District Manager at Chico, Calif., he had charge of Shasta and Keswick Dams and power plants, the 20,000-acre Orland project and studies of future water and power developments in northern California. He was assigned to the Branch of Operation and Maintenance in the Commissioner's Office in Washington, D. C., early this year, from which position he resigned to start work with the committee on April 2, 1951.

Carr is a native of Redding, Calif., a graduate of the University of Santa Clara, a member of the American Society of Civil Engineers, and a registered civil engineer of California.

Congressmen Murdock and Engle have stated that Carr's services with the committee will not include participation in any of the hearings or consideration of the Central Arizona project. •

GRAND LAKE REGATTA

ON TOP OF THE ROCKIES—Sailboating at Grand Lake. At left is a miniature sailboat race, and above is the yacht race for the Sir Thomas J. Lipton Cup as seen from the Grand Lake Yacht Club. ***Both photos by N. T. Novitt, Region 7 photographer.***

by MARCELLA ALLEN, Technical Expert, Region 7, Denver, Colo.

Every summer for the last 50 years one of the highest sailboat regattas in the world (rivaling only those on 12,506-foot-high Lake Titicaca in South America) has been held on the roof of the Rockies, near the Continental Divide.

Grand Lake, a natural jewel in the chain of lakes in the Colorado-Big Thompson project, where this dramatic show takes place, never rises or falls more than 1 foot. Since it became part of the Bureau of Reclamation project, its level, and that of Shadow Mountain Reservoir, has been stabilized by control works and by pumping from Granby Reservoir, another link in the chain of lakes in the project. To maintain this balance, Granby's waterline may vary as much as 94 feet during a season.

For generations, families have been coming to Grand Lake for their vacations, and the rim of the lake is dotted with luxurious summer homes. Thousands of people visit this lake high in the mountains (8,367 feet elevation) each tourist season. Almost 344,000 people enter Rocky Mountain National Park through the Grand Lake entrance each year. The little town of Grand Lake (600 in population in the winter, 20,000 in the summer) depends upon the tourist business for its chief means of support. Many kinds of sport are available to tourists, but the highlight of the season is the boat regatta, held under the auspices of the Grand Lake Yacht Club, with the $1,500 silver cup, donated by Sir Thomas J. Lipton, yachtsman, as the prize for the Lipton Cup Races. The name of the winner and his boat are inscribed upon the cup each summer.

This cup was awarded personally to the Grand Lake Yacht Club (organized in 1901 and incorporated in 1902) in Denver City (as it was known to the oldtimers) on December 3, 1912, when the Yacht Club gave a dinner at the historic Denver Club for the famous English yachtsman. By that time the event had attracted considerable interest. In the early days of the Yacht Club, before the coming of the railroads, the competing yachts had to be brought in over Berthoud Pass (elevation 11,314 feet) by stagecoach over rutty, snakelike roads.

The first yacht race was an example of pioneering. Harry Bryant, a Denver attorney, and Richard Campbell, son-in-law of Senator Patterson, met in competition purely in a spirit of fun, both using a sort of rowboat rigged with homemade sails. Mr. Bryant won. Thereafter, both men raced many times, with first one winning, then the other. Finally, the Bryants and the Campbells joined to provide the Colorado Cup, now an annual trophy at these tradition-weighted races. The first scow was brought in by Mr. Campbell, and the first real sailboat was imported by Mr. Bryant.

Grand Lake does not afford easy sailing by any means. The wind changes with mountain fury

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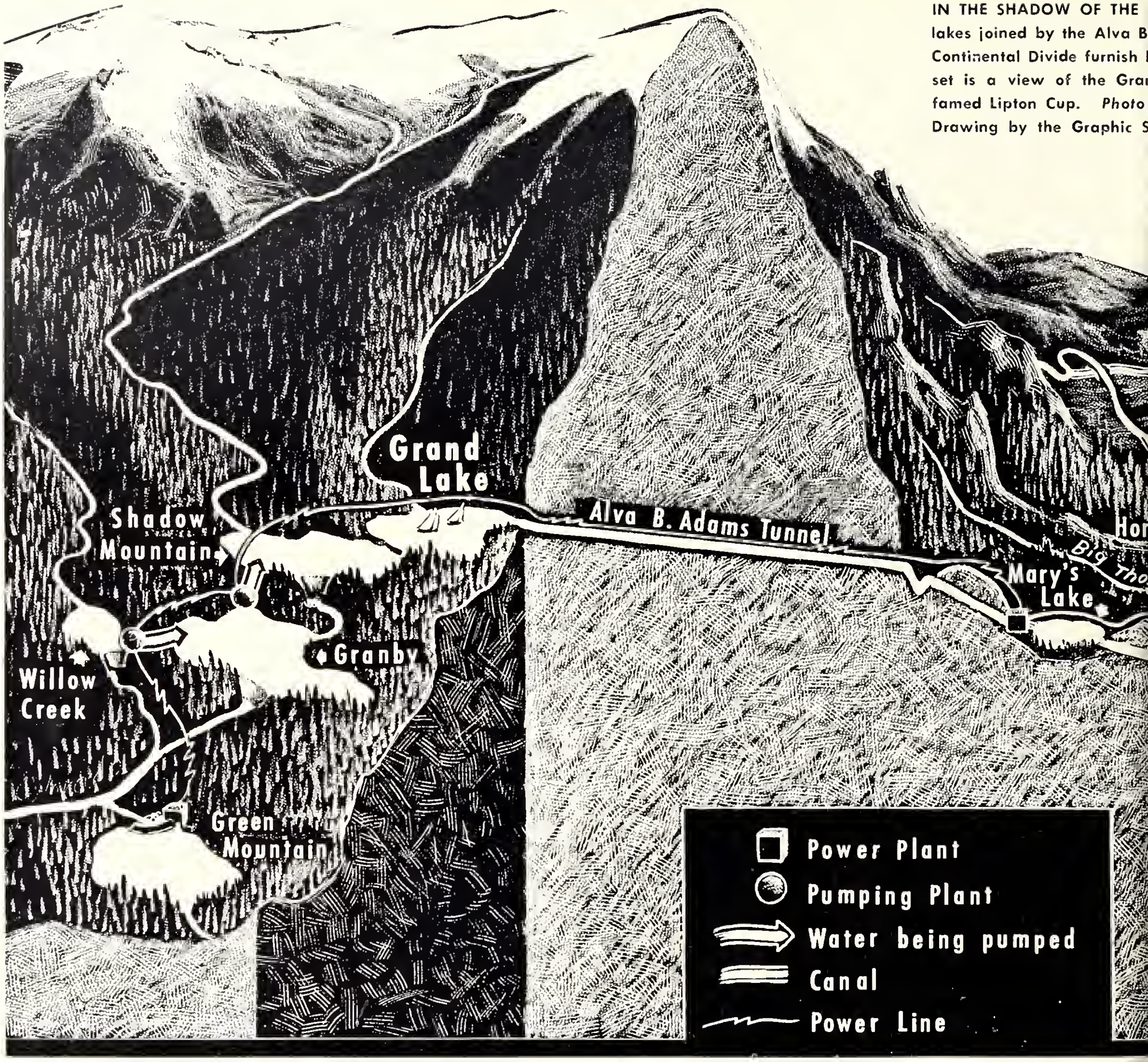
IN THE SHADOW OF THE
lakes joined by the Alva B
Continental Divide furnish
set is a view of the Gra
famed Lipton Cup. *Photo*
Drawing by the Graphic S



and speed, and experienced yachtsmen are spilled in the icy waters of the lake along with the beginners. None of these upsets are as tragic as that of the Grand Lake legend. According to the ancient story, the Utes were fleeing from the Cheyennes and Arapahoes who were invading North Park. The Utes (who evidently believed in "women and children first") loaded their squaws and papooses on hastily constructed rafts, expecting them to escape across the lake, while the braves remained to repel the raiders. One of the unpredictable mountain storms struck the lake and all were drowned. The saddened warriors quit the place, and to this day the Indians say the sighing of the pines is the wailing of the lost families.

Nowadays, the nattily rigged, sleek yachts bear little resemblance to the first sailboats, which were rigged-up rowboats, with a pine tree for a mast and bed sheets for sails. The whole event is carried on in the height of tradition and formality. The present commodore is Earl Coryell of Lincoln, Nebr. In a few instances a father and a son have had the distinction of having been commodore, each in their time. A year ago Richard Campbell, the son and grandson of two past commodores, Thomas Patterson Campbell and Richard C.

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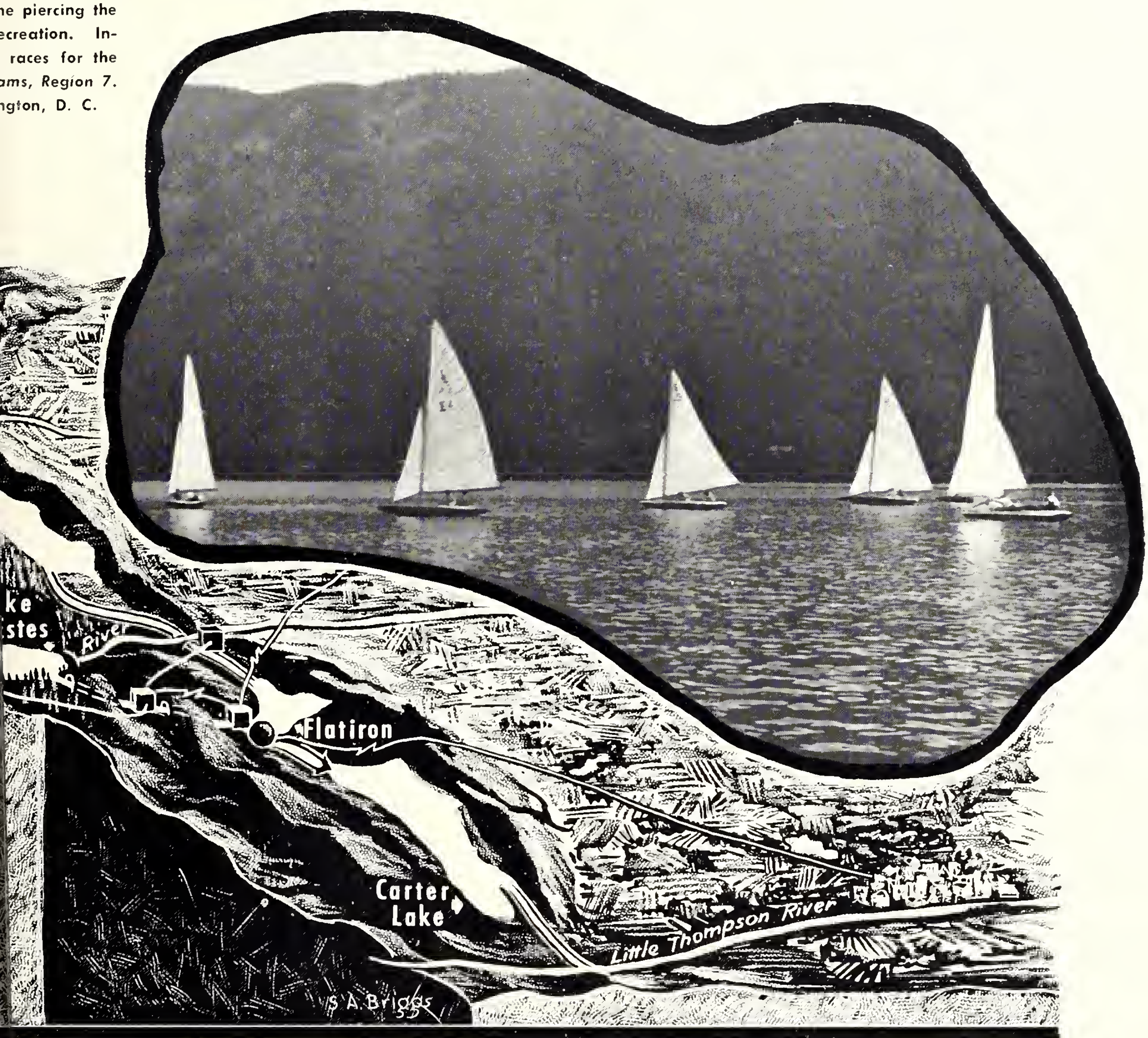


Campbell, was entered in the race for the Sir Thomas Lipton Cup.

Grand Lake is only one of many lakes on Bureau of Reclamation projects that offer unlimited recreational possibilities. On the east side of the Divide is Estes Park Lake, an artificial reservoir, another unit of the Colorado-Big Thompson project. It, too, has a great resort potential. The village of Estes Park has enjoyed a tourist population for many years but only now is the lake area becoming developed.

Over the tunnel, between the two lake sites, runs Trailridge Road (elevation at the pass is 12,183 feet). The opening of the road is marked each spring with a ribbon-cutting ceremony, amid snow banks and warmly clothed observers.

Alcova Reservoir, about 30 miles upstream from Casper, Wyo., is another lake that has had a boat regatta almost every year since 1936. Alcova has a rock-bouldered canyon for a shoreline, created by damming the North Platte River. It is located in a region where other recreation spots are not plentiful.

Also on the North Platte River are the Big Seminoe and Pathfinder and the smaller Guernsey Reservoirs, all in Wyoming.

(Please turn to page 129)

FUTURE FARMER OF AMERICA Lee Watenpaugh and one of the young registered Jersey heifers he is raising on his dad's farm in Meridian, Idaho, in addition to his farm chores and his public speaking. *Photo by Phil Merritt, Region 1 photographer.*

"Irrigation's Unsung Benefits"

A 17-Year-Old Farmer Looks at Federal Reclamation

EDITOR'S NOTE.—In a recent Southwestern Idaho District Oratorical Contest, Lee Watenpaugh, Meridian, Idaho, spoke on the subject "Irrigation's Unsung Benefits," and paid Federal Reclamation quite a tribute. A condensation of his inspiring talk is given here. After school, this 17-year-old youngster milks 11 registered Jerseys and runs 17 sheep and 20 head of cattle on a suburban 16-acre farm, owned by his dad, who works in Boise. Lee is vice president of the Ada County American Jersey Club, secretary of the Meridian F. F. A., and is milk tester for the Veterans' Administration in the county.

by LEE WATENPAUGH, Future Farmers of America, Meridian, Idaho

WE, THE FUTURE FARMERS OF AMERICA, who live in the West, are ever conscious of the bountiful production of our irrigated lands which were reclaimed through the tireless efforts of men of vision and fortitude. Out of the deserts 20 million acres have been reclaimed. It is estimated that 20 million more acres can be made to bloom with the magic touch of water.

Without these presently developed lands the West would not be as we now see it; a West with its many green valleys set as emeralds in the gray

"THE MAGIC TOUCH OF WATER"—A scene which indicates the direct benefits of irrigation—a field of hybrid sweet corn seed south of Nampa on the Boise project. Behind this scene are other important but often overlooked benefits pointed out in this article by a young farmer who knows whereof he speaks. ***Photo through the courtesy of the Crookham Seed Co., of Caldwell, Idaho.***

deserts which surround them; green valleys sparkling in the evening with myriads of scattered lights; lights in homes where wives prepare meals for hungry husbands and ravenous children; lights in barns where strong, healthy men finish the work of the day before enjoying the quiet peace of the evening. Such scenes indicate the direct benefits of irrigation, the benefits we can readily see and understand.

In these same green valleys, however, are also clusters of lights; clusters of lights that mark the places where, during the day, many people work, shop and play; places that have come into being because of the surrounding rich farm lands. The inhabitants of these villages and towns are the people who handle the farm produce for local use and for distribution throughout America. In turn these people, as well as their country neighbors, use products raised or manufactured in other parts of the United States. This creation of wealth, furnishing of employment and making possible the establishment of better, more successful homes are the hidden benefits I wish to mention. They are benefits we take for granted; benefits we too often overlook.

In the year 1900 a tricounty area in Idaho, composed of Twin Falls, Minidoka, and Gooding Counties, had fewer than 6,000 inhabitants and only 48,000 acres under cultivation. By 1940 the population had increased to 84,000 people and 627,000 acres of irrigated land had been added. Is this increase not impressive? Eighty-four thousand people in an area which had previously supported only 6,000!

In this area over one-half of the people live in towns a ratio of approximately one town person to one in the country. These townspeople, over 45,000 of them, are benefiting from irrigated agriculture.

If you wish these benefits to be stated in terms of dollars and cents, the records show that for every dollar invested in the farm, slightly over a dollar is invested or created in the form of urban, railroad or public utility property. Moreover, for every dollar invested in country property over a dollar is received every year by city folks in the form of fees and payrolls, all because the irrigated farms produce so abundantly.

There is no way to measure, with much accuracy, how these indirect benefits affect the people elsewhere in the United States. We do know, however, that the people of irrigated areas must have furniture, farm machinery, automobiles, gasoline, oranges, and like products. The best estimate available is that it takes at least one person outside the area to provide these things for each person within the irrigated area.

A commentary on benefits to the Nation is that during the last 21 years the people of major irrigated areas in the Pacific Northwest have paid into the United States Treasury enough income taxes alone to equal the cost of constructing the

projects. What a tremendous amount must also be realized from revenues collected beyond this tax!

Fabulous as it may seem, the indirect benefits of irrigation development do not end here. In the development of water for these farm lands, great dams, the largest in the world, are built to impound water for release to hungry acres. Advantage is taken of this stored water to develop much needed power. Power produced by water that cascades through giant penstocks into turbines which in turn revolve tremendous generators that whirl day in and day out to produce electricity. Electricity to light homes. Electricity to turn the wheels of industry. Electricity for security purposes to keep America free and strong.

The purpose of constructing the Grand Coulee Dam was to bring a million acres of land in the State of Washington under irrigation. However, it also made possible the production of power. It was because of the power produced from waters behind this dam that the production of the atomic bomb became possible. It was partially because of this power that aluminum, much needed to build airplanes for World War II, could be produced.

In addition to these there are still other benefits. Crystal clear streams and reservoirs teem with trout for the sportsmen's enjoyment. Great dams hold back the spring runoff and thereby prevent disastrous floods, and regulate the rivers for navigation.

Having recognized these tremendous benefits, both obvious and hidden, that are created through the development of irrigated lands, is there any doubt what should be the destiny of those millions of acres still thirsting for available water? The great task of developing those thirsty acres rests upon our shoulders—both the present and future farmers of America. We farmers must work in close cooperation with our city neighbors, for they too must share this great responsibility. What a challenge to us all to serve our community, our Nation, yes even the entire world, in performing this inspiring task. THE END.

Work on Flatiron Power and Pumping Plant Under Way

The Bureau of Reclamation awarded a contract to Winston Bros. Construction Co. of Monrovia, Calif., on April 11 to build the Flatiron power and pumping plant, dam, afterbay, and appurtenant works. This feature of the Colorado-Big Thompson project will have one of the highest water drops on any Reclamation project. The 1,055-foot waterfall will shoot out from Bald Mountain tunnel, enter the Flatiron dual purpose plant, which will churn water through the turbines for hydropower and also pump irrigation water into Carter Lake for irrigating thirsty acres in northeastern Colorado. Another unusual feature of the development is the use of the Francis type wheel or reaction wheel for a head in excess of 1,000 feet. Heretofore the Pelton type turbine or impulse wheel has been used exclusively on heads exceeding 1,000 feet.

For the second time in reclamation history, a pumping or generating unit has been called upon to serve in a unique dual role. During slack periods of the day, when the demand for irrigation water has been met, the 10,000-kilowatt unit will be thrown into reverse. Instead of pumping water into Carter Lake, the Flatiron unit will draw upon the reservoir reserve to generate power for peak load demands. The other similar Reclamation installation is located in Utah on the Strawberry Valley project which the Bureau started constructing in 1906. •

Security Restrictions on Shasta Tours

Although stringent security measures have been in effect since last year at Shasta and Keswick Dams, supervised guided tours of Shasta Dam will be continued on a limited basis.

The public will be escorted across the dam roadway, down the passenger elevator, and to the north entrance of Shasta power plant on regularly scheduled tours. This will allow a view of the plant's interior without close proximity to vital installations.

Other vital areas at the Shasta Dam and power plant will be closed to the public, and additional guards have been posted on a 24-hour basis.

Reclamation officials have ordered Keswick Dam and power plant, 9 miles downstream from Shasta, closed to the public, and additional guards posted there. Entrance to vital installations at Shasta and Keswick will require passes approved by the operations superintendent at Shasta Dam. •

HOME IN THE WEST—on the Roza Division of the Yakima project in eastern Washington, shown above, with World War II Veteran Richard Ormiston and his father. Five years ago the farm looked like the photo at left—80 acres of sagebrush—when Private Ormiston was on leave from the hospital, having been wounded in combat on Mindora Island. Now he and his father have an attractive home on this once barren land, and productive fruit orchards.

Construction Resumed on San Joaquin

Regional Director Boke, Sacramento, announced early in March that the Bureau is resuming construction of irrigation distribution systems in the San Joaquin Valley. This announcement was made after California's Attorney General Edmund C. Brown reversed his predecessor's position and supported the validity of the 40-year contract between the Ivanhoe Irrigation District and the Government, pending before the Superior Court of Tulare County.

The Bureau halted its construction plans when the validity of the contract was attacked in the courts with the support of former Attorney General F. N. Howser.

The controversy involved the construction of a 2,700-mile distribution system from the Madera and Friant-Kern Canals. •

PG & E Signs Wheeling Contract for Central Valley Power

On April 2, 1951, a 10-year contract was executed between the Pacific Gas & Electric Co. and the Bureau of Reclamation to carry Central Valley project power over P. G. & E. lines in the Central Valley of California.

Under the terms of the contract, power generated at Bureau plants in the Central Valley project will be delivered to the company system at Tracy, Calif., whenever excess carrying capacity is available, and be transmitted to preference customers of the Government in the Sacramento and San Joaquin Valleys and in Solano, Contra Costa, Alameda, and Santa Clara Counties. The Government will pay P. G. & E. for this wheeling service at specified rates. •

SHORT CUTS TO WEED KILLING CALCULATIONS

PART 3—RAISING THE BOOM

DID YOU KNOW YOU COULD SPRAY your weeds, crops, or insects twice, using the same amount of chemical per acre simply by raising the boom of your spray rig?

How high to raise the boom is a question you can answer easily by referring to the nomogram included as figure 9 in the "Handbook of Weed Control Calculations" written by John T. Maletic, Soil Scientist and Weed Control Specialist of the Bureau of Reclamation's Region 7, in Denver, Colo.

This is the third in our series of articles demonstrating the use of the handy charts or nomograms in Mr. Maletic's book which contains methods for quickly figuring the calculations needed for applying chemical weed killers. In many cases, these nomograms can also be used for calculations included in spraying crops for diseases or for insect control.

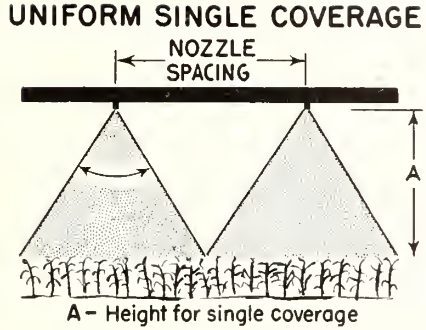
Figure 9 which appears on the next page entitled Nomogram for Determining the Height of Boom Required to Obtain Single or Double Coverage of Spray Above Vegetation, can help you to make sure of getting an even application of spray solution on the weeds you want to kill. If you do not have the spray boom and nozzles at the proper height above the weeds you may get too much chemical on some strips and not enough on others. Single coverage with a low boom, where the fanlike sprays just meet above the weeds, may be necessary on windy days or where the spray might drift and endanger nearby crops. For the same reason, the boom must always be kept at exactly the correct height, neither too high nor too low, for all applications, whether single or double coverage is intended.

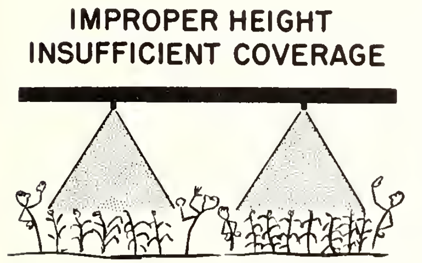
Double coverage, using the same amount of chemical per acre, distributes the sprays more uniformly and helps eliminate the possibility of leaving unsprayed strips. Each strip of plants is covered by spray from three nozzles, getting half the spray from each of two nozzles and all the spray from one. As the spray fans out and the rig travels over the plants, each plant is thoroughly drenched. An additional advantage to double coverage is that it is especially good for operating on rough ground where the boom height changes.

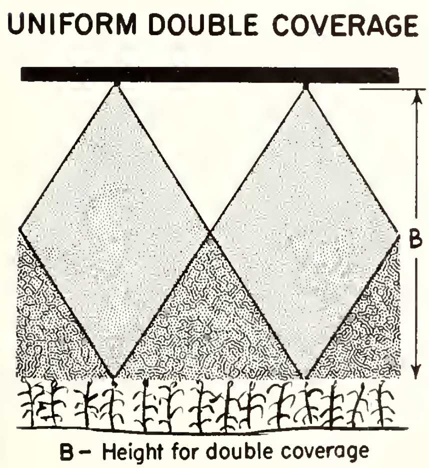
To use the chart you will first have to find out how many inches apart the nozzles are spaced on the boom, and at what angle the nozzles deliver the spray. Just measure the space between the nozzles and look at the markings on the nozzles themselves—the angle is usually marked on each one, 60°, 90°, etc. However, the angle of the spray varies somewhat with the pressure used, high pressure spreading out the angle of the fan, and low pressure reducing its spread, just as it does in a water faucet. It is a good idea to get a chart from the manufacturer of the nozzles which will show you the angle they will give at the pressure which you have at the boom. The angles of many of the nozzles obtainable on the market are rated at around 40 pounds pressure.

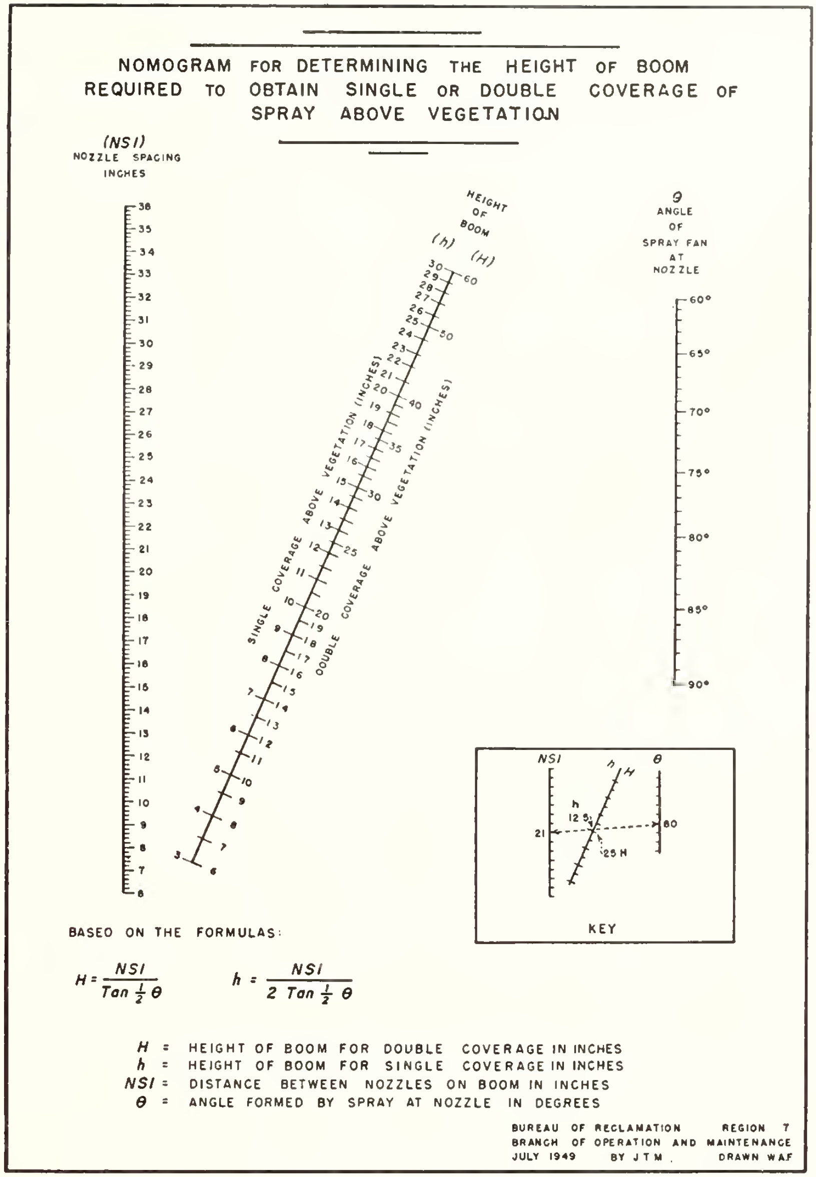
Suppose you find your nozzles to be spaced 21 inches apart (as illustrated in the key in the corner of the nomogram) and you learn that under the pressure you will use, your nozzles will deliver the spray at an 80° angle? Simply take your straight edge (a transparent one is best) and connect the figure 21 on the left hand scale (NSI, short for Nozzle Spacing in Inches) with the figure 80° on the right-hand scale (θ, the Greek letter theta, often used as a symbol for "angle"). The answer will be found at the point where your straight edge or rule crosses the center diagonal scale (small h for single coverage, capital H for double coverage). In our example, you would set your boom 12½ inches above the weeds to get single coverage, or 25 inches above the vegetation if you want double coverage. As a matter of fact, the height of the boom for double coverage is just twice as much as for single coverage.

To figure the height of your boom from the ground up, now that you know the distance from the top of the weeds, simply measure the height









HOW HIGH THE BOOM is raised above the tops of the weeds determines how effective your spraying campaign will be. You can use the nomogram to figure the height of the boom and it is up to you what kind of a dose to give the weeds, using the same amount of chemical. The weeds at the top of the page are being well covered, but those below may escape the deluge. Those at the bottom haven't got a chance. Nomogram from *"Handbook of Weed Control Calculations"* by *John T. Maletic*. *Drowings by Graphics Section, Washington, D. C.*

of the weed growth and add that to the answer you got from the chart.

For double coverage, or 100 percent overlap of the spray, be sure the edge of the spray from one nozzle does not strike the spray of the nozzle next to it, and spoil the spray pattern, dispersing the conflicting sprays in all directions. Staggering the nozzles on alternate sides of the boom, or tilting the angle of the nozzles will avoid this occurrence.

(Reprints of this series, in the handy page size of the ERA, *are now available. Send your requests to your nearest Regional Director. See inside back cover of this issue. Reprint #1 was based on the nomogram which tells you how to get the most for your money when you are buying liquid weed killers. Reprint #2 was entitled "Finding the Killer in the Dust" and served the same purpose for weed-killing dusts or powders.)*

Natural Resources "Not Expendable," Says Chapman

Secretary of the Interior Oscar L. Chapman recently warned all heads of bureaus and offices in his Department that treating resource conservation programs as expendable luxuries in the national emergency would jeopardize the basic economic foundations upon which our long-range military security and peacetime welfare depend.

The Secretary declared that the problems of building up the military machine have quite properly demanded first attention since Korea, but he also asserted, "This, however, is only the first step in our defense program. The second or long-range phase of this defense effort calls for the maintenance of a high level of military preparedness without jeopardizing the economic strength of the Nation."

In urging all Interior officials to give renewed emphasis to the Department's vital responsibilities, the Secretary outlined three basic steps: (1) Cooperate fully with the work of the Materials Policy Commission established by the President to study broad, long-term aspects of the Nation's materials problems, (2) stress departmental efforts in long-range resource planning and programing to firm up needs and goals in the light of the world situation, and (3) improve machinery for translating identified needs into action proposals for consideration of the President and the Congress. •

First Missouri Basin Contract for Kansas OK'd

Assistant Secretary of the Interior William E. Warne executed the Kansas-Bostwick Irrigation District contract on April 20, on behalf of the United States. This is the first Missouri Basin project contract negotiated in Kansas and provides for the irrigation of 49,000 acres in the northern part of the State on the Bostwick Division of the project.

The Bostwick Division of the Missouri Basin includes about 100,000 acres in Kansas and Nebraska (See "The Bostwick, Nebraska, Contract," Reclamation Era, May 1949 and "Bostwick Unit" Reclamation Era, December 1950) which will receive the main water supply from the Harlan County Reservoir being built on the Republican River near Alma, Nebr., by the Corps of Engineers.

Kansas District water users will pay an annual rental for water service and, at the close of a 5-year development period, start repayment to the Government of $3,500,000, which represents the cost of the district's water distribution system and will be paid in 40 equal annual installments.

The Kansas-Bostwick District has been divided into irrigation blocks which will permit orderly development in accordance with construction progress on the project. Present plans call for the initial delivery of water through the Bostwick pumping plants in 1952 and completion of the project in 1958. •

Sixteenth Central Valley District Seeks Irrigation Water

When Secretary of the Interior Oscar L. Chapman approved the form of the long-term water service contract with the Contra Costa Water District it marked the sixteenth district which has negotiated for irrigation water on this project. The contract has been sent to the water users for acceptance.

Negotiations are now under way with more than a score of other districts for sale of Central Valley project water and all of the Friant-Kern supply has been either contracted for or committed for future use. Under the Contra Costa contract a maximum of 86,000 acre-feet will be delivered annually for agricultural, municipal, industrial, and domestic use. Over 7,000 acres will receive 63 percent of the water for supplemental irrigation.

Under previously executed contracts eight Central Valley irrigation districts received supplemental water for the first time in 1950. These districts received 103,677 acre-feet of water during the year, representing almost 22 percent of the total amount of water used to irrigate 172,205 acres. On these lands $46,620,801 worth of crops, mostly fruits, nuts, forage, and cotton were grown, amounting to an average per acre return of $260.16. This is based on the net area in cultivation—179,201 acres. •

Hungry Horse Fills Blood Bank

On Thursday, April 5, 1951, the people working on the Hungry Horse Dam and power plant in Montana chalked up another record for this history-making project.

They donated 208 pints of blood to the American Red Cross, which according to Dr. Paul McBride, in charge of the American Red Cross blood-mobile unit from Great Falls, Mont., represented one of the most successful blood-donor programs ever held in that State. •

GRAND LAKE REGATTA

(Continued from page 121)

Along the Republican River in Nebraska, more lakes are being created by new Bureau of Reclamation projects. Like the Wyoming lakes, they are coming into being in an area where few lakes or other recreational facilities exist. There are Enders Reservoir, Swanson Lake, Medicine Creek Reservoir, and Harlan County Reservoir, the latter now under construction by the United States Corps of Engineers. Coming up in the near future will be Horsetooth, Carter Lake, and Willow Creek in Colorado, and Cedar Bluff in Kansas. These areas are being eagerly developed to provide clean family fun throughout the whole of the Reclamation West. These recreational benefits are among the multiple purposes of Reclamation-built structures. THE END.

In Memory of George Albert Smith

The RECLAMATION ERA hereby pays tribute to, and mourns the passing of, George Albert Smith, president of the Church of the Latter Day Saints, on April 5, 1951. To his successor, David O. McKay, Secretary of the Interior Oscar L. Chapman wrote, "the world lost one of its great spiritual leaders and humanitarians in the death of your beloved president, George Albert Smith. I shall always treasure the afternoon he spared me for a visit in Washington last year and mourn with you and the members of your church in his passing."

Commissioner of Reclamation Michael W. Straus sent the following telegram to new leader McKay, "The leadership of George Albert Smith in the conservation and development of the natural resources of the West for the benefit of humanity is well known. Like the other great leaders of your church, he had a keen interest in making the desert 'blossom as the rose,' and only last year discussed with me personally plans for the Upper Colorado River development as another step in this great effort. We, in the Bureau of Reclamation, join with you in mourning the passing of a great man."

NEW HEADQUARTERS FOR COLUMBIA RIVER DISTRICT

FINISHING TOUCHES and cleanup work just before the Columbia River District employees moved into their new headquarters at Ephrata, Wash. The flagpole at left had yet to participate in a flag-raising ceremony. *Photo by Ellis Shorthill, laboratory technician, Columbia River District Office.*

On April 22, 1951, Bureau of Reclamation employees officially moved in to the new headquarters building of the Columbia River District in Ephrata, Wash. Previously, part of the district staff worked in temporary quarters. Others traveled daily between Ephrata and Coulee Dam, commuting the 60-mile distance. Eight divisions in all moved into the new building; programs and finance, personnel, land acquisition, information, legal, supply, project development and safety. The project development division had been stationed a quarter-mile to the southeast of the new building. The irrigation construction and operation and maintenance divisions will move into the quarters vacated by the project development staff.

H. A. Parker, District Manager, who has been commuting to Coulee Dam since his appointment on October 21, 1950, will now be "at home" on the second floor of the Headquarters Building at "C" and Division Streets. Phil Nalder, Assistant District Manager, has come down from Coulee Dam, where all remaining responsibilities at the dam are under the direction of A. F. Darland, Supervising Engineer of the Coulee Dam Division.

With this move, the Bureau employees will be able to give on-the-spot service to the irrigation farmers and people in the area who have dealings with the Bureau in connection with the fast-growing Columbia Basin project.

WATER REPORT

May first forecasts of 1951 water supplies for Western States promise to depart but little from the April first forecasts released in the RECLAMATION ERA. According to the latest snow survey information released by the Soil Conservation Service and its cooperating agencies, the northwest may still expect adequate and perhaps excessive runoff in a few localized areas, and the northern tier of inter-mountain states also will fare very well for water. The southwestern drought was not relieved during April.

Sectional forecasts based on May first snow survey data are summarized in the following paragraphs:

COLUMBIA BASIN—Above normal snow pack that existed at the end of March has been considerably reduced, particularly at lower elevations by high April temperatures. These high temperatures have probably been accompanied by high evaporation losses. This, together with abnormally low precipitation during April, will result in runoff somewhat less than that forecasted April 1. It is estimated that the inflow to Okanagan Lake will be 10 percent less than that forecast. The amount of reduction in other basins of British Columbia will probably be very small.

The water supply outlook for irrigation and power remains good to excellent throughout the basin.

In general, snow cover throughout Columbia Basin is still above normal, although proportionately lower than on April 1 due to the warm, dry spring prevailing to date. Potential high water on the Kootenai, Methow, and Okanogan rivers was reduced by the high flows during April. However, these rivers may still rise to dangerous levels and precautionary measures should be taken to protect vulnerable areas.

With the exception of western Montana, valley precipitation throughout the basin was far below normal for April, which reduces the seasonal volumes of water forecast on April 1 by about 6 percent.

A heavy storm April 28–30 deposited twenty to forty inches of snow on the higher elevations and eight to ten inches of snow at lower elevations in western Montana. The Flathead river should flow about 150 percent of average during this season. The Clarks Fork river should flow at least 130 percent of average. These flows will be less than in either 1950 or 1949. In the Upper Columbia river basin of Montana, water supply for irrigation and power will be sufficient this season for all needs.

UPPER MISSOURI—May 1 snow surveys on the Upper Missouri and Yellowstone rivers in Montana indicate an excellent irrigation water supply for this coming season. The May first snow pack on headwaters of the Yellowstone river is above average and a good water supply is anticipated for the Yellowstone Valley. May–September flow at Corwin Springs should reach 1,770,000 acre feet or 7 percent above the 10 year average. Snow pack on the Jefferson is heavier than last year, while on the Madison and Gallatin is less than last year, but slightly above average.

Snow surveys on the Musselshell and Judith rivers indicate runoff slightly below average in prospect. However, spring and summer precipitation play a very important part in the water supply from these midstate mountain ranges.

May 1 snow surveys on the Wind and Popo Agie river basins indicate a good water supply for those basins for this season. The Wind river above Riverton is likely to produce a record year's runoff. Reservoir storage on Missouri river in Montana is good, along with the storage in northern Wyoming. Those portions of eastern Montana not supplied by snow fed streams are beginning to feel the effects of the deficient precipitation over that section during the winter and spring months. The October–April precipitation over eastern Montana is 63 percent of average.

ROCKY MOUNTAIN STATES—Colorado water supply outlook has not changed materially since April first. The snow cover on the South Platte remains great. In many cases the snow cover is greater than any since snow surveys began. Areas of heaviest snow cover are on the headwaters of Boulder Creek, Clear Creek and Thompson river. The extreme headwaters of the Arkansas are also very good, but some of the southern tributaries are deficient in snow. The Blue river drainage, tributary to the Colorado, is still unusually high in snow cover. The southern part of the state continues definitely deficient in snow. Streamflow throughout the area is generally below normal due to delayed snow melt.

Snow cover on the Green river in Wyoming is as great or greater in some cases than last year when it reached record maximum. Precipitation during April approximately was normal in the high watershed of the Snake river in western Wyoming. No change in the seasonal runoff as forecast on April 1. Good water supplies are forecast for the Jackson, Wyo. area and adjacent lands below in Idaho.

The water outlook for Rio Grande in New Mexico continues to be critically poor, with practically no snow and well below normal precipitation during April.

INTERMOUNTAIN STATES—In general there is no major change in the water supply prospect for Utah. The first half of April was dry with high temperatures which accelerated streamflow. About mid-April, cool temperatures, still continuing, reduced streamflow so that runoff for April has been only normal or below, even in areas where total seasonal runoff is still expected to be considerably above normal. Precipitation for April as a whole was normal or above. Therefore, about the same runoff as forecast a month ago is expected to occur.

May first measurement of key snow courses indicates that very damaging peak flows may still occur in Northern Utah.

In Southern Utah, high precipitation at the month's end only slightly improved water supply prospects. Streamflow here will still be near a record low. Indicative of southern Utah is the Beaver river. Only 4 times in the last 38 years has streamflow been as low or lower than it was this April.

The drought in central and southern Nevada continues. There has been little improvement during the past month in the outlook for irrigation season water supplies. Above normal mountain snowfall during April has very slightly improved the prospects, but in all areas except for Humboldt Basin snow water conditions on May 1 were far below normal. Cool weather during April, and above normal precipitation in valley areas reduced the April demand for irrigation water. This was helpful in conserving limited stored supplies for use later in the season.

PACIFIC COAST—Marked lack of rainfall and abnormally heavy snow melt

and snow evaporation during April reduced prospective runoff for most of Oregon's streams. However, most of the State can still be confident of good water supplies, although late season deficiencies of water are now expected on many small streams deriving supply from low elevation watersheds. Water stored in reservoirs is 5 percent above average for May 1, but in a few important reservoirs supplies are below normal.

The over-all April-July streamflow expectancy for California, as a result of observations of snow courses, precipitation, temperature, and antecedent runoff made during April, shows that sufficient irrigation water will be available on the main stem of the Sacramento River; while on all of the rivers to the south, deficiencies will occur. On the Kern and Kaweah, the water deficiencies will be the greatest of record.

SOUTHWEST—The water supply outlook for Arizona has not improved since April first. Combined total reservoir storage is 2 percent less than a month ago, the combined storage being 5 percent of capacity or 170,000 acre feet. However, due to general mountain snowfall near the last of April in one large storm, the forecast of February–June inflow to major reservoirs is increased from 140,000 to 150,000 acre feet.

No change is reported in water allotments for 1951 in Gila and Salt River projects, nor in the acreage being seeded. Salt and Verde Rivers still flow close to their minimum base.

(The above was submitted by R. A. Work, research project supervisor, of the Federal Cooperative Snow Surveys.)

CROPS

Minidoka Crops Near $64,000,000

Farmers on the million-acre Minidoka project in the Upper Snake River Valley in southern Idaho raised crops valued at $63,900,173 during 1950.

While this return was considerably below that of the peak year 1947 it compared favorable with 1949's gross of $66,716,944. The average gross per acre return was $64.75 compared with $67.91 in 1949. Lands receiving both full and supplemental water supplies from Reclamation constructed facilities were included in the roundup.

Wheat brought the highest gross return ($15,174,210) while sugar beets led as the highest per acre crop ($135.41). Alfalfa hay was second in gross value and potatoes third. The Twin Falls Canal Co. led in gross returns for individual districts with $14,669,000 for 202,700 acres, an average of $72.37 per acre. ●

Boise Crops Hit 25¾ Million

When the final results were tallied on crops grown in the Boise Reclamation project in Idaho during 1950 they revealed that the total value was $25,744,938.

This amount represented crops grown on 306,644 acres served by Reclamation facilities. About two-thirds of the land received a full supply of water while the other third received supplemental water. The gross per acre average value for all crops was $83.96 compared with the all-time high of $104.21 in 1948.

Sugar beets topped the list in gross values showing a total of $5,184,255 or $171.69 per acre for 30,195 acres. Alfalfa was second with a total value of $4,267,379 and wheat was third at $2,554,225.

Pasture and cherries also hit the million-dollar mark, with cherries exceeding the $550 per acre value. However, the highest gross per acre return came from hops, almost $882 per acre for approximately 1,000 acres. One-quarter of the project was in alfalfa, wheat was next in acreage, and sugar beets third.

Farmers in the Black Canyon Irrigation District, newest of the Boise project developments, are continuing to increase the acreage under cultivation and the per-acre gross return. In 1950 they produced crops valued at $465,000, or a per acre average of $39.03, on approximately 12,000 acres, compared with what they raised in 1949 on 5,500 acres. In that year crops were valued at $184,000, or $33.61 per acre. In 1948 crops produced by these farmers on 2,100 acres were worth a total of $15,583, or a gross per acre average of $7.48. ●

RELEASES

New Maps Available

The Drafting Section of the Bureau of Reclamation has recently completed the following project maps: Central Valley project, California; Salt River project, Arizona; W. C. Austin project, Oklahoma; Gila project, Arizona; and Colorado-Big Thompson project, Colorado. These maps are available in both the small (10½ by 17 inches) and large (21 by 34 inches) sizes. The following maps are only available at present in the small 10½ by 17 inch size: Riverton project, Wyoming; Hanover Unit, Big Horn Division, Missouri River Basin project, Wyoming; and Crow Creek Pump Unit, Three Forks Division, Missouri River Basin project, Montana. These maps are all in color, and requests should be sent to the nearest regional director (see directory on inside back cover of this issue), specifying the name and size of the maps desired. Single copies are free to those who have need of them in connection with their work or studies. ●

POSTSCRIPTS

That's a Joke, Son!

A preacher attended a golf tournament. He dubbed shot after shot, he sliced, hooked, topped. Finally he yelled at the top of his voice, "Grand Coulee, Grand Coulee."

His caddie, surprised at this outburst, asked the preacher what it meant.

"My son," replied the cleric, "That is the biggest dam in the world." ●

Don't Miss a Copy of Your ERA!

You'll find the expiration date of your subscription on the address label which wraps your copy of the RECLAMATION ERA. If the number at the left-hand side of the address, directly beneath the number and street reads "9–51," for example, the last issue under your subscription will be September 1951.

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NOTES FOR CONTRACTORS

Contracts Awarded During April 1951

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DS-3293	Davis Dam, Ariz.-Nev.	Apr. 27	Supervisory control and telemetering equipment for Knob, Blythe, Maricopa, and Phoenix substations, Parker and Davis power plants, and Phoenix dispatchers' office.	Control Corp., Minneapolis, Minn.	$44,776
DS-3300	Columbia Basin, Wash.	do	5 lots of equipment, 30 mobile radio transmitter-receiver assemblies, and 12 lots of alarm receiving equipment for Quincy, Ephrata, Adco, Moses Lake, and Winchester, Wash.	Radio Corp. of America, Camden, N. J.	42,785
DC-3306	Colorado-Big Thompson, Colo.	Apr. 11	Construction of Flatiron power and pumping plant and afterbay dam, Estes Park-Foothills power aqueduct.	Winston Bros. Co., Monrovia, Calif.	2,240,359
DC-3307	Eklutna, Alaska	Apr. 9	Construction of 6 3-bedroom and 6 2-bedroom residences, 2 10-car garages, streets, and utilities for Eklutna government camp.	Denali Construction Co., Anchorage, Alaska.	389,436
DS-3311	Davis Dam, Ariz.-Nev	Apr. 17	1 lot of equipment for selectively calling substations and power plants of region 3 power dispatching system.	Electrical Communications, San Francisco, Calif.	20,650
DS-3312	Missouri River Basin, Wyo	Apr. 5	1 10,000-kilovolt-ampere autotransformer for Lovell substation, schedule 1.	Pennsylvania Transformer Co., Canonsburg, Pa.	41,766
DS-3312	do	do	3 115,000-volt and 1 69,000-volt circuit breakers for Lovell substation, schedule 3.	Pacific Electric Manufacturing Corp., San Francisco, Calif.	85,743
DS-3312	do	do	8 115,000-volt disconnecting switches for Lovell substation, schedule 4.	Schwager-Wood Corp., Portland, Oreg.	20,806
DC-3315	Columbia Basin, Wash	Apr. 3	Construction of earthwork and structures for East Low Canal and Lind Coulee wasteway.	J. A. Terteling & Sons, Inc., Boise, Idaho	3,490,304
DC-3318	Missouri River Basin, S. Dak.	Apr. 2	Construction of 72 miles of Fort Randall-Winner 115-kilovolt transmission line.	Orlando Construction Co., and Louis Orlando, Coleman, Wis.	604,169
DS-3319	Rio Grande, N. Mex	Apr. 5	1 5,000-kilovolt-ampere shunt reactor, 1 14,400-volt circuit breaker, and 2 15,000-volt disconnecting fuses for Albuquerque substation, schedules 1, 3, and 5.	General Electric Co., Denver, Colo.	26,462
DC-3320	Cachuma, Calif	do	Construction of Lauro Dam	Clyde W. Wood & Sons, Inc., North Hollywood, Calif.	723,512
DS-3321	Missouri River Basin, Nebr	do	3 42- by 30-foot radial gates and 3 counterweight frames for spillway at Trenton Dam.	Johnson Machine Works, Inc., Chariton, Iowa.	133,789
DC-3327	Central Valley, Calif	Apr. 16	Construction of laterals 124.5E, 127.7E, and 130.4E and sublaterals, including reservoirs and pumping plants, unit 3, Southern San Joaquin municipal utility district, Friant-Kern Canal distribution system, schedule 2.	United Concrete Pipe Corp., Baldwin Park, Calif.	1,671,177
DC-3333	Gila, Ariz	Apr. 12	Construction of earthwork and canal lining for Wellton Canal	Morrison-Knudsen Co., Inc., Los Angeles, Calif.	973,945
DC-3334	Columbia Basin, Wash	Apr. 26	Installation of heating and ventilating system for units R1 to R9, right powerhouse, and supplemental and miscellaneous heating and ventilating systems for left powerhouse, Grand Coulee power plant.	Dorrington Sheet Metal Works, Denver, Colo.	83,426
DC-3336	do	do	Construction of State highway 10-A, grading and paving streets and parking areas, and construction of drain inlets, sidewalks, curbs, and retaining wall in town of Coulee Dam, Wash.	McAtee and Heathe, Spokane, Wash.	187,496
DC-3338	Colorado-Big Thompson, Colo.	Apr. 12	Construction of 22 miles of Gore Junction-Muddy Pass 69-kilovolt transmission line.	Smith Hi-Line Co., Nashville, Tenn.	209,490
DC-3343	do	Apr. 16	Construction of Willow Creek Dam	Peter Kiewit Sons' Co., Omaha, Nebr.	1,294,706
DS-3346	Hungry Horse, Mont	Apr. 9	Miscellaneous structural steel, including platform, stairs, and handrailings, for generator room at Hungry Horse power plant.	St. Joseph Structural Steel Co., St. Joseph, Mo.	23,600
DC-3347	Columbia Basin, Wash	Apr. 25	Construction of earthwork and structures for Rocky Coulee drain wasteway, EL 29 B wasteway, DE 226 wasteway, and EL 20 wasteway No. 2, Rocky Coulee drain wasteway system, East Low Canal laterals.	Intermountain Plumbing Co., Inc., and Henry L. Horn, Moses Lake, Wash.	128,520
DS-3353	Colorado-Big Thompson, Colo.	Apr. 20	Steel structures for 115-kilovolt switchyards for Flatiron power and pumping plant and Pole Hill power plant.	American Bridge Co., Denver, Colo.	29,418
DS-3354	do	Apr. 27	1 25-ton overhead traveling crane for Willow Creek pumping plant.	Moffett Engineering Co., Albany, Calif.	14,710
117C-96	Columbia Basin, Wash	Apr. 10	Construction of garages, warehouse and storehouse at O. & M. Headquarters, Quincy, Wash., schedule 1.	E. O. Johnson Co., Spokane, Wash.	56,799
117C-96	do	Apr. 17	Construction of garages, warehouse and storehouse at O. & M. Headquarters, Othello, Wash., schedule 2.	W. J. Park & Sons, Yakima, Wash.	71,334
117C-98	do	Apr. 6	Construction of fencing and protective structures, West Canal, station 351+72 to 2,044+50 and Winchester Wasteway, station 0+00 to 964+00.	Arnold B. Pontius, Spokane, Wash.	122,634
100C-120	Hungry Horse, Mont	Apr. 11	Relocation of East Side forest service telephone line	McWaters and Bartlett, Boise, Idaho.	94,418
300C-18	Boulder Canyon, Ariz.-Calif.-Nev.	Apr. 2	Construction of physical education and industrial arts buildings at Boulder City.	Lembke Construction Co., Las Vagas, Nev.	443,620

Construction and Materials for Which Bids Will Be Requested by August 1951

Project	Description of work or material
Boise, Idaho	Construction of roads in Anderson Ranch Dam area.
Central Valley, Calif	Construction of Columbia and Mowry outdoor-type pumping plants and reaches of Columbia and Mowry Canals on the Delta-Mendota Canal distribution system, located 8 miles southeast of Firebaugh, Calif.
Do	6 propeller-type, 33.3 cubic feet per second capacity and 2 horizontal, centrifugal-type, 15 cubic feet per second capacity pumping units for pumping plants Nos. 1 and 2, Columbia Canal; and 2 propeller-type, 5 cubic feet per second capacity pumping units for pumping plant on Mowry Canal, Delta-Mendota Canal distribution system.
Central Valley, Calif	Motor-control switchgear, distribution switchboards, and float switches for Southern San Joaquin municipal utility district No. 3.
Do	Construction of 40- by 70-foot reinforced concrete administration building at Tracy switchyard.
Do	Construction of 102- by 322-foot steel warehouse at Folsom power plant.
Do	3 oil-pressure actuator-type 231,000-foot-pound capacity governors for the 74,000-horsepower turbines at Folsom power plant.

Construction and Materials for Which Bids will be Requested by August 1951—Continued

Project	Description of work or material
Colorado-Big Thompson, Colo.	Construction of Rattlesnake Dam, a 105 foot high, off-stream, 400,000 cubic yards, earth-and-rock fill structure having a 10,400 cubic foot per second capacity spillway, 14 miles west of Loveland, Colo.
Do	Construction of 2,100 feet of concrete-lined Pole Hill Canal and 500 feet of concrete bench flume to carry a capacity of 550 cubic feet per second from outlet of Pole Hill tunnel to penstock inlet at Pole Hill power plant.
Do	1 76-inch butterfly valve for Flatiron power and pumping plant.
Do	Generator voltage bus and circuit breaker for Pole Hill power plant.
Do	Main control boards, supervisory control boards and supervisory and carrier equipment for Flatiron power and pumping plant and Pole Hill power plant.
Do	1 460-volt distribution board, 3 motor- and heating-control boards, 2 125-volt battery chargers, 2 500-kilovolt-ampere transformers, and 1 37½-kilovolt-ampere transformer for Pole Hill power plant.
Do	Motor control switchgear for Willow Creek pumping plant.
Columbia Basin, Wash.	Furnishing and placing armor rock and riprap rock for slope protection of river channel downstream for Grand Coulee Dam.
Do	Construction of 292 cubic feet per second capacity, 10 unit Babcock pumping plant, a 23- by 135-foot concrete substructure with steel or concrete superstructure on lateral W35.9 of West Canal, 3 miles southwest of Quincy, Wash.
Do	10 centrifugal-type electric motor driven pumping units of 17 to 30 cubic-feet-per-second capacities for Babcock pumping plant.
Do	Construction of 17 miles of laterals, 36 miles of sublaterals, 14 miles of drain wasteways for lateral area W-6A on West Canal.
Do	Construction of 15.5 miles of unlined Potholes East Canal, 1,800-cubic-feet-per-second capacity, and 5 miles of unlined Ringold wasteway, 1,800 cubic-feet-per-second capacity, 6 miles southeast of Othello, Wash.
Do	Construction of Royal watermaster headquarters and temporary construction camp about 7 miles north of Corfu, Wash.
Do	Constructing streets, walks, and mechanical and electrical utilities at Eltopia, Wash.
Do	Completion of electrical installations in industrial area at Grand Coulee Dam; completion of machine shop and warehouses A and B; fencing for feeder canal and industrial area; construction of retaining wall for right powerhouse parking area; enclosure of end of assembly building and drainage facilities at vista sites; and comfort station at Greene Athletic field.
Do	Furnishing and installing lawn sprinkler systems and landscaping at O. & M. sites at Adco, Ephrata, Mesa, Moses Lake, Warden, and Winchester, Wash.
Do	Erection of 80-foot span bridge, furnishing and constructing 69-foot span timber county road bridge superstructure on Rocky Coulee wasteway, and gravel surfacing for 1,700 feet of county road.
Davis Dam, Ariz.-Nev.	Fabricated galvanized structural steel for transformer circuit structures for Davis 69-kilovolt switchyard and installation.
Do	Construction of paint shop, washing and greasing building, vehicle repair shop, service station, and storage sheds.
Do	Erection of steel structures and installation of additional electrical equipment for Tucson substation.
Do	Erection of steel structures and installation of electrical equipment for 20,000-kilovolt-ampere Cochise substation.
Do	Main control board for 230-, 115-, and 13.8-kilovolt circuits for Prescott substation.
Deschutes, Oreg.	Clearing Wickiup reservoir area near Bend, Oreg.
Eklutna, Alaska	2 vertical-shaft Francis-type hydraulic turbines, each 24,000 horsepower at 807-foot head, for Eklutna power plant.
Klamath, Oreg.-Calif.	Construction of laterals and drains for N Canal area second extension on the Tule Lake sump, including raising canal banks and removing existing pumping plant outlet structure, and construction of new outlet structure.
Do	Improvement of a channel for Lost River in Upper Langell Valley, about 20 miles east of Klamath Falls, Oreg.
Kendrick, Wyo.	Construction of Bairoil stubstation, including structural steel and installing electrical equipment.
Do	2 160-inch turbine butterfly valves for Alcova power plant.
Missouri River Basin, Mont.	1 9.04- by 9.04-foot fixed wheel gate lifting frame, 1 gate engagement indicator, and 4 gate slot closures for Canyon Ferry Dam.
Do	1 main control board, 1 annunciator relay cabinet, 1 1,500-kilovolt-ampere unit substation, 1 460-volt board, and 2 5-kilowatt battery chargers for Canyon Ferry power plant.
Missouri River Basin, Nebr.	Construction of Franklin south side pumping plant, 5 miles of unlined Franklin south side canal, 5 miles of laterals, and 2.8 miles of drains near Franklin, Nebr.
Missouri River Basin, S. Dak.	Construction of 2,000-kilovolt-ampere Bonesteel substation.
Do	Construction of 6,000-kilovolt-ampere Winner substation.
Do	Construction of 3,750-kilovolt-ampere Gregory substation.
Do	First stage construction of 10,000-kilovolt-ampere Woonsocket substation.
Missouri River Basin, Wyo.	Construction of 6,000-kilovolt-ampere Sinclair substation.
Provo River, Utah	Placing 3,000 feet of buried asphalt membrane lining in Weber-Provo diversion canal, located northeast of Kamas, Utah.
Rio Grande, N. Mex.	Construction of 20 miles of Rio Grande River drainage and conveyance channel and levee above Elephant Butte Reservoir.
Yakima, Wash.	Construction of 2 miles of drainage way consisting of earth ditch and concrete pipe with appurtenant reinforced concrete structures near Grandview, Wash.

United States Department of the Interior
Oscar L. Chapman, Secretary
BUREAU OF RECLAMATION OFFICES

Washington Office: United States Department of the Interior, Bureau of Reclamation, Washington 25, D. C.

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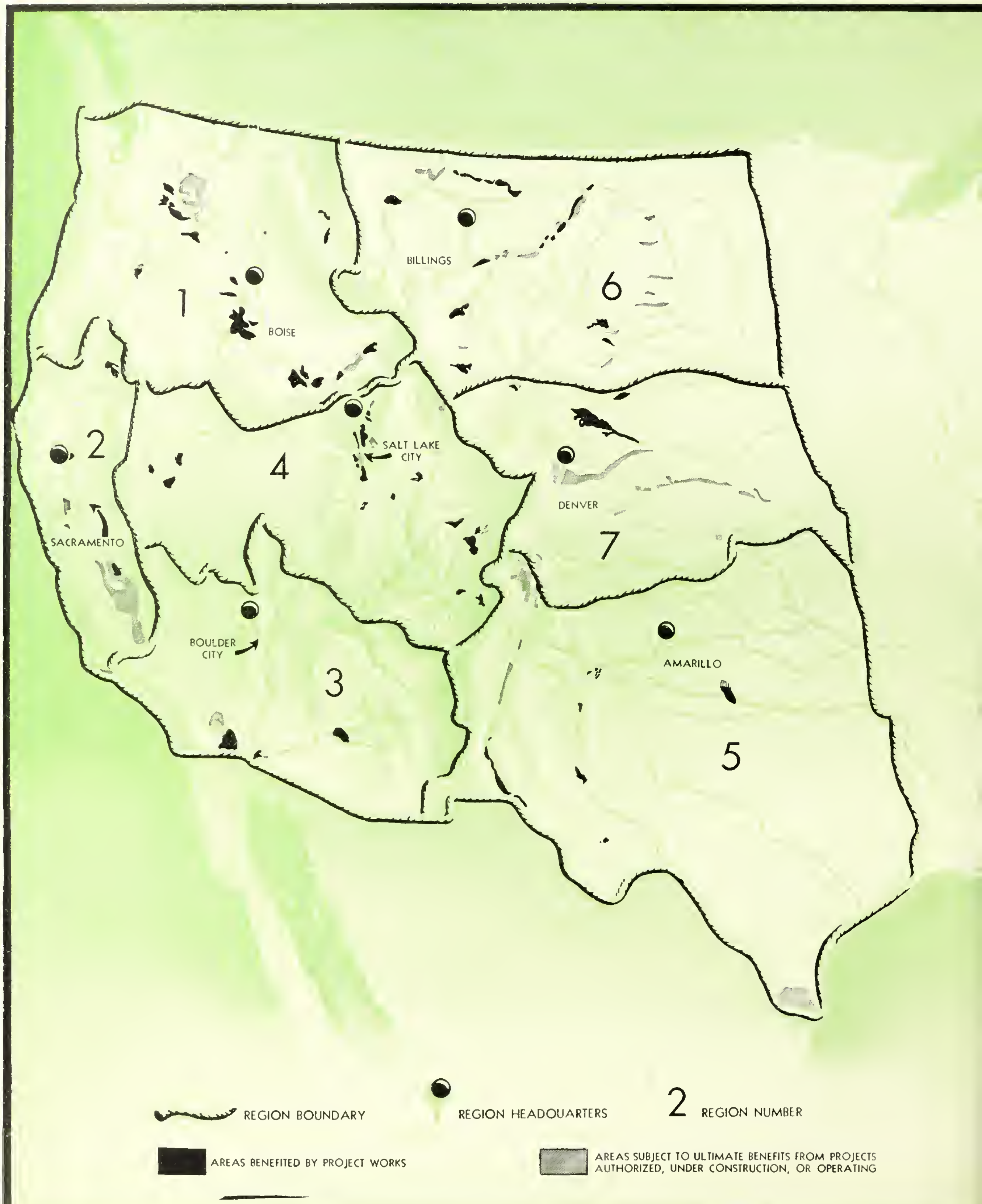

THE RECLAMATION AREA

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BUREAU OF RECLAMATION OFFICES---------- Inside back cover

Ruth F. Sadler, *Editor*

Subscription rate $1.50 a year for persons residing in the United States and Canada; $2 a year for foreign subscriptions; special rate of $1 a year for members of water users' associations, and Bureau of Reclamation employees.

OUR FRONT COVER

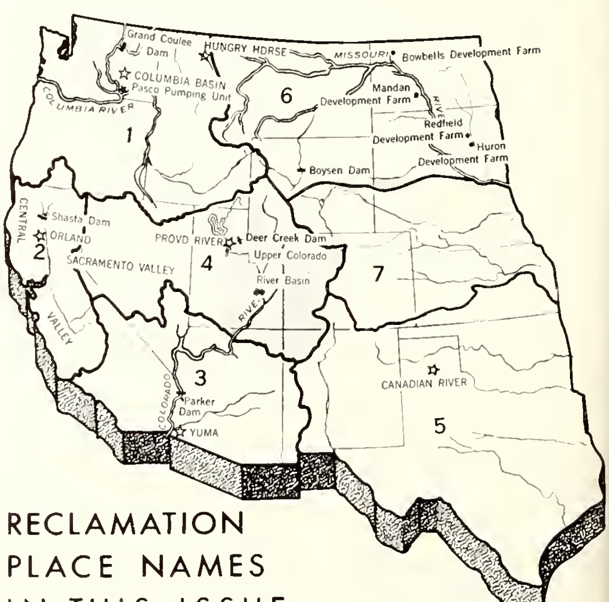
FREEDOM—symbolized by the Nation's famous Liberty Bell—is the heritage of all American children. Although they are too young to understand, Billye Gayle McCloud, left, and Kathy Criswell, children of Bureau of Reclamation employees at the Hungry Horse project in Montana, are tolling the keynote on which this Nation was founded—the right to live under a free and democratic government "of the people, by the people, and for the people." *Photograph by A. E. McCloud, Hungry Horse project photographer, Region 1.*

30 YEARS AGO IN THE ERA

Results of Irrigation by the Reclamation Service

In the business world any undertaking that cannot make a profit will almost certainly show a loss, and this is the rule under which the Secretary of the Interior must administer these numerous large projects if we consider dollars and cents in the reclamation fund alone. In the administration of the reclamation law for 20 years and the investment of upward of $120,000,000 from the reclamation fund, it is now estimated that about $5,000,000 or less than 5 percent, are chargeable to the several items suggested above for which there is no return in sight.

In a broader sense, against this loss to the fund may be set down the new wealth exceeding a half billion dollars and the large annual crop values that have resulted from effort based on the investment of the reclamation fund. (From p. 302, July 1921 issue of the RECLAMATION RECORD, predecessor to the RECLAMATION ERA.)

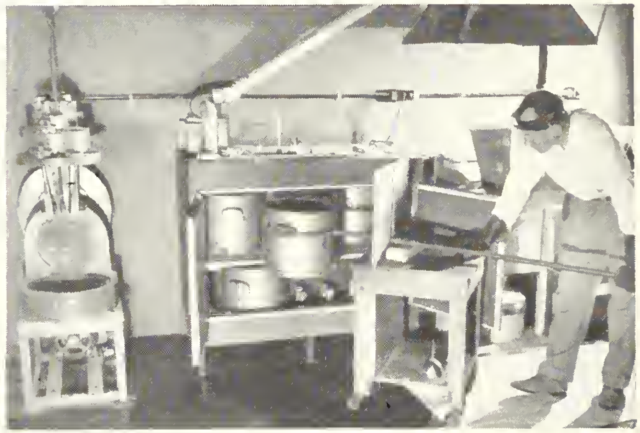


RECLAMATION PLACE NAMES IN THIS ISSUE

RISING ABOVE ITSELF—Arrow points to the biggest pumping plant in the world which began lifting the Columbia River above itself, back into its Ice Age Channels on June 14, 1951. Across the Nation, in Washington, D. C., Secretary of the Interior Oscar L. Chapman gave the signal for the pumps to start operating. On the scene in the State of Washington was Commissioner of Reclamation Michael W. Straus, proud of the engineers who had accomplished the unprecedented construction feat, scheduled for May (see "The Big Lift" on p. 86, May 1951 *Reclamation Era*). District Manager of the Columbia Basin project H. A. Parker reports that major structures to irrigate the first 87,000 acres of the project are on schedule. The map, looking south, shows the flow of water from Grand Coulee Dam, at bottom, by gravity to the project lands which begin almost 60 miles south. Ultimately 1,029,000 acres will be irrigated, providing vitally needed agricultural products for civilians as well as our military forces. *Drawing made by Russ DuCette, Region 1.*

Radioactive Fertilizers

ATOMIC SCIENCE HELPS SOLVE SOIL PROBLEMS



AGRICULTURAL ATOMS—Weighing in a shipment of radioactive phosphate at the Plant Industry Station at Beltsville, Md., above. At right, manufacturing "tagged" superphosphate fertilizer. Note that great care is being used to protect the operators from harmful radiations. *Photos by W. J. Mead, Bureau of Plant Industry, Soils and Agricultural Engineering, U. S. Department of Agriculture.*

by L. B. NELSON, Soil Scientist, Division of Soil Management and Irrigation, Bureau of Plant Industry, Soils, and Agricultural Engineering, United States Department of Agriculture, Colorado A. & M. College, Fort Collins, Colo.

How much fertilizer phosphorus do crops use? What is the best kind of phosphate to use on different soils and different crops?

By means of "tracers," radioactive materials furnished by the United States Atomic Energy Commission are furnishing answers to these and many other questions important to agriculture.

Phosphorus, which is essential to the life of plants and animals, has been activated and used as a "tracer" in phosphate fertilizers, which contribute so much toward successful farming. Here in the West, for example, we use over a million tons of fertilizer each year—much of it containing phosphate and most of it going on irrigated lands. Even a small improvement in the use of phosphate means a huge saving in dollars and cents.

The "Tracer" Idea

The idea of tracers is simple. If you mix 1,000 white marbles with a basketful of white marbles, pull out a sample and try to find out the proportion of the original 1,000 to those already in the basket—you cannot do it. But if you "tag" the original 1,000 with 100 black marbles, then pull out your sample and count the black marbles, you know that each black marble is equal to 10 of the original 1,000 and you can calculate easily the proportion of added marbles to the total. Most Westerners are familiar with this; it is the old idea of "tagging" a band of sheep with blacks.

The procedure with radioactive tracers follows closely this same principle. Suppose you want to find out the amount of phosphorus in a crop coming from an application of phosphate, or the amount coming from the soil. First, a phosphorus compound is placed in an atomic pile at Oak Ridge by the Atomic Energy Commission and bombarded with neutrons until the phosphorus becomes active. Then it is shipped to the Plant Industry Station of the Bureau of Plant Industry, Soils, and Agricultural Engineering at Beltsville, Md. There, in a special manufacturing plant, the active phosphate is incorporated uniformly with the phosphorus in phosphate fertilizer—i. e., the phosphate

fertilizer is "tagged" with radiophosphorus. The "tagged" fertilizer is shipped to the field and applied on small plots. After the crops feed on the fertilizer, the proportion of fertilizer phosphorus to soil phosphorus taken up by the plant is obtained by determining the total amount of phosphorus in the plant by chemical analysis, and by counting the tagged phosphorus.

The phosphorus coming from the fertilizer is easy to determine because one of its radioactive phosphorus atoms decomposes every now and then and gives off a radiation. The radiations are counted by a delicate instrument commonly known as a Geiger Counter. Since one-half of the radioactive phosphorus is destroyed every two weeks, the tagging is good for only about four months.

Radiophosphorus Studies in the West

Research with phosphorus-tagged fertilizers has been going on in the West since 1948. The work is a joint undertaking between the State experiment stations, the Bureau of Plant Industry, Soils, and Agricultural Engineering of the United States Department of Agriculture, and the Atomic Energy Commission. So far work has been conducted on irrigated lands in Colorado, Arizona, Idaho, Oregon, Washington, and Utah. This year, additional new work is being undertaken in Montana, North Dakota, South Dakota, Nebraska, Kansas, and California. The work under irrigation in North Dakota is being done in cooperation with the Bureau of Reclamation on the Bowbells and Mandan Development Farms, and in South Dakota on the Redfield and Huron Development Farms.

What the Results Are Indicating

Let us look at some of the findings here in the West. First, you may be surprised to know that in any one season crops actually use only a small amount of the fertilizer phosphorus applied. This seldom exceeds 12 to 15 percent, even on low-phosphorus soils. On the other hand, the more phosphorus there is available in the soil, the more soil phosphorus in the plant.

There are many different kinds of phosphate fertilizers. Which are the best for western soils? The studies have shown that superphosphate, ammonium phosphate, and phosphoric acid usually are the best. Calcium metaphosphate supplied less phosphorus to the crops than superphosphate in the early stages of growth, but about the same amounts thereafter. The phosphates of low solubility, such as dicalcium phosphate and tricalcium phosphate, are of less value on western soils, particularly the first year of application.

POURING IT ON—At extreme left, radioactive fertilizers, shipped to the field in mason jars, are emptied into the belt-delivery hopper of the distributor planter through a lead adaptor. ***Photo by Colorado A. & M. College.*** **At immediate left, Dr. Sterling Olsen at Fort Collins, Colo., measures the radioactivity of plants grown on soils to which radioactive phosphate has been added. The plant material is placed under a Geiger tube housed in the lead shield.**

How should phosphate fertilizer be applied to the soil? Results show that plants usually get the most out of fertilizers during the early stages of growth, if you apply the phosphate close to the seed. Later in the season, the most effective

(Please turn to page 147)

WATER BUFFALO clearing weeds in major drains of Pontine marshes (upper left). Street scene in San Giovani in Fiori, a town in the Calabria region of Southern Italy (at right), during a visit by the ECA Reclamation Mission. *Left photo by Bruni. Photographer for other photo unknown.*

Reclamation under the Marshall Plan in Italy

by W. E. CORFITZEN, Reclamation Specialist,
Economic Cooperation Administration, Rome, Italy

Part One—HOW THE PROGRAM BEGAN

On April 3, 1948, Congress enacted the Economic Cooperation Act of 1948 (Public Law 472), carrying into law the principles of European economic recovery enunciated by General George Marshall in his famous address at Harvard University on July 5, 1947. Thus was created the Economic Cooperation Administration (ECA) which has been popularly known as "the Marshall Plan." It is also often referred to as the European Recovery Program (ERP).

As a result of this legislation the United States made available to Italy about $600,000,000 for the first year of operation (1948–49). A novel plan was devised for rapidly improving the Italian national economy. It will be recalled that following the war all European countries found themselves with a scarcity of almost every conceivable article. Black markets flourished. Luxury items commanded the highest prices, and merchants naturally endeavored to import those items on which they could make the greatest profits. In view of the extreme shortage of foreign exchange and the urgent need to improve the basic economy, the Marshall Plan operated as follows:

Merchants who wanted to import commodities made application to the Italian Government for an import license and if, after examination, the Government was satisfied that the commodity was needed to improve the national economy, a license was granted. The merchant paid the price of the commodity in lire to the Italian Government which deposited the money in the National Treasury to what was known as the "Counterpart Lira Fund." With merchants importing food, steel, machinery, spare parts, and all the other many items needed to restore basic economy, a large counterpart fund was built up. To spend this sum for the rapid improvement of the national economy, the Italian Government prepared a budget with the advice and assistance of the ECA Mission. Seventy billion lire was allocated to Agriculture—about $117,000,000. Of this amount, $70,000,000 was allocated for reclamation projects. This program envisaged a total expenditure for reclamation projects of about $300,000,000 during the period of ECA assistance (until July 1, 1952).

About the author—Ed Corfitzen began his career as a civil engineer in the hydraulic laboratory of the Bureau of Reclamation in Denver in 1933, specializing in sedimentation and related engineering problems. While in Denver he enrolled in and graduated from the University of Denver Law School and was admitted to the Colorado Bar in 1940. Combining engineering and law, he was transferred to administrative engineering duties on the Commissioner's staff in Washington where he was responsible for coordinating activities on the Water Conservation and Utilization Program. During the war he organized the Foreign Activities Section of the Bureau to more efficiently assist the State, War, and Agriculture Departments and various embassies when these agencies sought specific aid on reclamation. In 1947 he was loaned by the Bureau to the State Department to serve as Reclamation Specialist on the American Mission for Aid to Greece. Upon completion of this assignment, his services were requested by ECA. While his primary responsibility is the Italian Reclamation program, he also serves on the staff of the Special Representative in Paris as Reclamation Consultant to all other countries in the ECA orbit having reclamation projects.

Italy is essentially a hilly and mountainous country, having a total area of 30,906,000 hectares, (or 76,337,820 acres, 2.47 hectares equalling 1 acre) all but 2,367,000 of which are productive and of which 12,753,000 hectares (31,499,910 acres) are arable.

Water control and the construction of hydraulic works are old sciences in Italy, having started before the Roman Era. In the province of Lombardy there are important irrigation projects which began about 1100. By the end of 1905 the total area irrigated was estimated at 1,500,000 hectares (3,750,000 acres). By 1939 many projects had been constructed, utilizing surface and underground water supplies, and the area was increased to 2,100,000 hectares (5,250,000 acres). During this same period many swamps, such as the Pontine Marshes south of Rome, were reclaimed by the installation of large pumping plants, and plans were accordingly made for the extension of the reclamation program.

During the war many of these projects suffered damages, either actual war damage or deterioration caused by lack of maintenance. The end of the war found a number of projects with plans, which had been prepared prior to the war, and ready for expansion. But reorientation was required, especially in view of the lack of national funds, and social pressures and pressing requirements for additional food. Consequently, the Ministry of Agriculture, the Ministry of Public Works, and the National Land Reclamation and Irrigation Association undertook a study of the problems in the light of the then pressing and future requirements. It was decided that three principal problems existed:

1. Readjustment of water supplies and changes in obsolete irrigation systems.

2. Coordination of irrigation and power projects.

3. Coordination of planning activities and extension of irrigation systems.

This was the status of the program when the ECA Mission began operations in Italy in the summer of 1948. Of the 18 countries participating in the Marshall Plan, the Italian reclamation program was so far advanced that it was decided to send a reclamation specialist to Italy to concentrate on that program until programs for other countries could be presented and considered at a later date.

Preliminary examination revealed that the reclamation program in Italy involved considerably more than do reclamation programs in the United States. In the United States, generally, flood control, drainage, irrigation and incidental power developments are included, while the Italian program includes not only these aspects but also many others which would be required to develop

(Please turn to page 141)

STARK EVIDENCE of parched acres is the farm above, abandoned for lack of water. ACRES OF ALMONDS at right were made possible by irrigation. *Top photo by W. H. Colby, right photo by Ben Glaha, both of Region 2.*

Canals for Sacramento Valley

A DEMONSTRATION OF AMERICAN DEMOCRACY AT WORK

by DONALD M. SMITH, Secretary, Sacramento Valley Irrigation Committee, Red Bluff, Calif.

MORE THAN GOLD HAS BEEN DISCOVERED IN CALIFORNIA.

We, the people of four Sacramento Valley counties, discovered the secret of success.

We discovered how to keep our sights leveled on our objective, and work together for the common good. In doing this, we learned a lesson in democracy.

We farmers and agricultural leaders from Tehama, Glenn, Colusa, and Butte Counties began to be alarmed by dropping water tables. We knew what dry years meant. We knew what we needed and wanted—water.

We also knew that when the Central Valley project was authorized in 1935, it provided for canals on the east and west side of the Sacramento River. Of course, at that time, we did not think we would need them for about a quarter of a century. But World War II, a boom in population, a demand for increased agricultural production, and the subsequent drain on water supplies brought us smack up against the future. The

Sacramento Valley canals were no longer a dim and distant plan, but a sharp and present need.

Obstructionists claimed it was impossible. Too many warring factions, too much red tape. Nevertheless, we got in touch with our elected representatives to the Congress of the United States, and with public officials who were in charge of the Central Valley project in our area. And in November 1948 we held a regular Town Meeting (or Valley meeting, as it turned out to be) at the Hotel Maywood in Corning, Calif. Men of opposite political beliefs, of varied interests, of different creeds, and many who were total strangers to one another talked the situation over with Representative Clair Engle and people from the Bureau of Reclamation. Out of that meeting came the Sacramento Valley Irrigation Committee, and a determination to put "first things first" and get a bill passed which would authorize construction of Sacramento River Canals as a part of the Central Valley project.

A little less than 2 years later, we met at the same place, in the same room, to celebrate the passage of Public Law 839 by the Eighty-first Congress, authorizing federally constructed works to irrigate nearly a quarter million acres in the rich, but dry, Sacramento Valley.

During those 2 years none of us were loafing or letting the other fellow do the job.

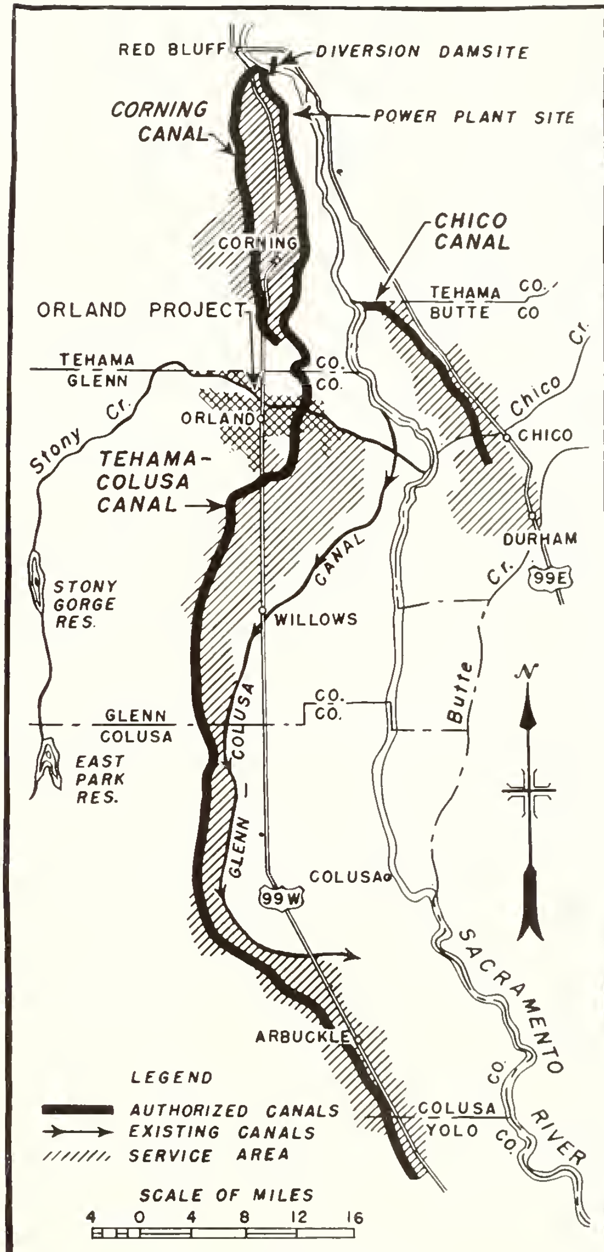
We stated our case to the Governor of California. He gave the project his unqualified and emphatic endorsement. So did his State Water Committee.

Twice, members of the Sacramento Valley Irrigation Committee traveled across the Nation to present their problem before Congress. What Congress learned from these farmers paved the way for unanimous consent of both Houses for approval of Public Law 839.

Sam Decker, member of the committee's Butte County unit, told the Senate that when he ran his pumps, his neighbors have no water, and have to irrigate at night while he pumps during the day to make full use of the available water. He convinced the committee members that the canals will make water cheaper and give the farmers the security of crops every season. Marshall Lane, chairman of the Glenn County board of supervisors, who has a diversified farm in the Bureau of Reclamation's Orland project, and George Otterson, Glenn County supervisor and a stockman for the past 30 years, both testified before members of the Senate, stressing the plight of Sacramento Valley's dairy and livestock industry, and urging action on the canals.

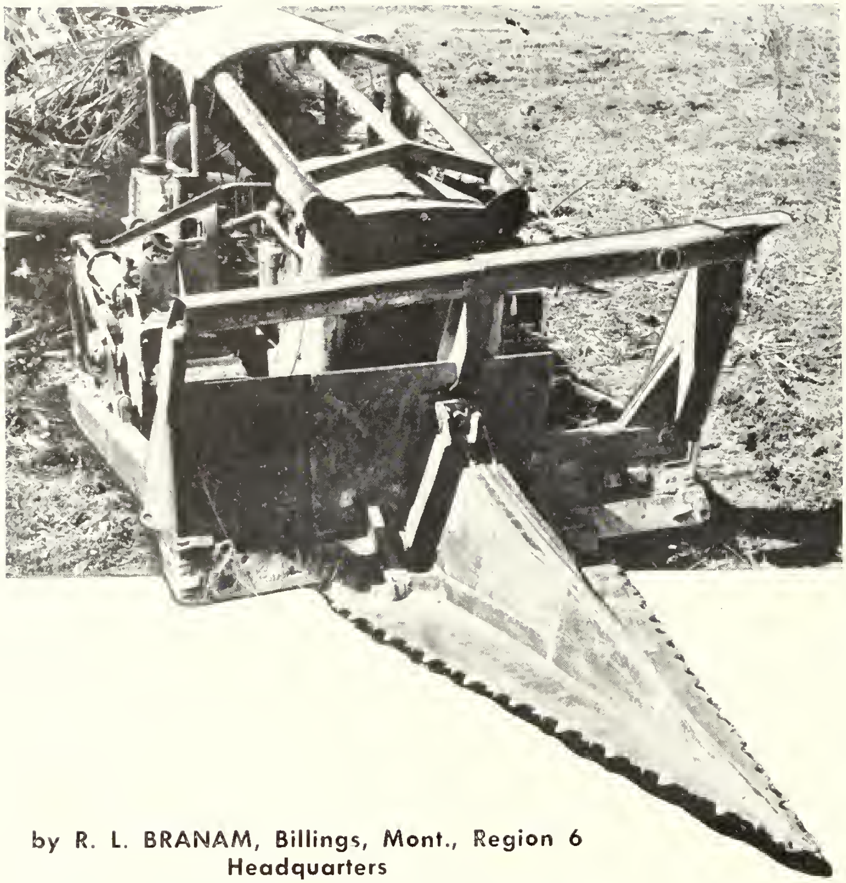
Max Vann of Williams, Calif., was the committee's chairman. For the past 30 years he has

(Please turn to page 151)



SACRAMENTO VALLEY CANALS
CENTRAL VALLEY PROJECT

ALMOST A QUARTER OF A MILLION ACRES of rich but dry land in California's Sacramento Valley can be watered by the canals authorized by Public Law 839 as shown in map at right.



GIANT BLADE AT BOYSEN

THE SNOUT—This swordfish-like blade attached to a bulldozer is felling trees faster than the mythical Paul Bunyan. *All photos in this article by T. R. Broderick, Region 6.*

by R. L. BRANAM, Billings, Mont., Region 6 Headquarters

A MACHINE WHICH BETTERS THE WOODCUTTING PROWESS of the mythical Paul Bunyan is in operation in the clearing of trees in the reservoir area of the Bureau of Reclamation's Boysen Dam, now under construction on the Bighorn River about 20 miles south of Thermopolis, Wyo.

Trees up to 24 inches in diameter fall with a single swipe of the 6-foot-long **V**-shaped saw blade which is attached to a bulldozer challenging Bunyan's "blue ox" for sheer strength.

The spectacular cutting job is an innovation introduced into reservoir clearing operations in this area by the Mid-States Construction Company of Chisholm, Minn., and which has been adopted by six other contractors engaged in reservoir clearing operations for the Bureau of Reclamation in Wyoming.

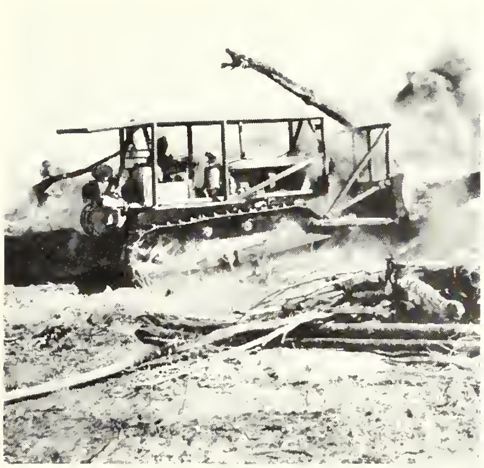
With the use of the mammoth saw, which has teeth on each side, a single dozer can fell as many trees as could be cut by five chain saws and crews. Because of the resultant saving of time, it is expected that the reservoir area will be cleared of all growth by July 1, 1951, beating the originally scheduled time by more than 6 months.

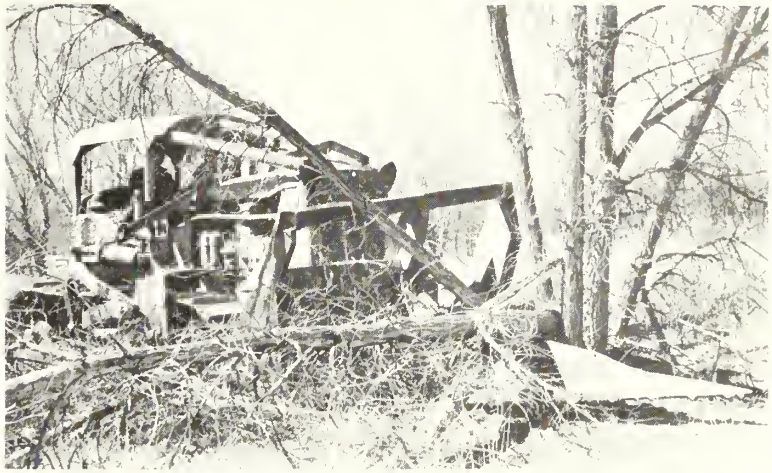
The operation is extremely simple. The dozer operator guides the saw so that it strikes the tree near the point of the cutting edge and then forces the saw through the trunk, cutting, with a single pass, cottonwood trees with a diameter up to 24 inches. A single machine can fell up to 5 acres of dense timber in 8 hours. In areas with less cover, 10 acres can be cut in an 8-hour shift.

In Boysen Reservoir, the contractors also have adapted a rake arrangement to the dozer blade. The heavy tines extend below the blade about 8 inches and gather brush and other growth as the dozer blade collects the cut trees and uproots the smaller trees not felled with the saw blade.

The saw blade, with which it is possible to cut the trees at ground level, has several variations at Boysen, with the six contractors engaged in clearing Boysen Reservoir using slightly different blades and teeth arrangements. Some of the blades are finely cut and kept sharp; others work with a tearing action and do not require sharpening.

The six contracting firms presently engaged in clearing operations at Boysen are Asbell Bros. of





Riverton, Wyo.; Lichty Construction Co. and Brasel & Whitehead of Riverton; A. M. Conrad of Big Piney, Wyo.; Watkins & Pennington of Fort Collins, Colo.; Linquist, Olson & Co. of Cambridge, Minn.; and Mid-States Construction Co. C. L. Hubner Co. of Denver recently completed a clearing contract. The total area to be cleared under the seven contracts amounts to 12,722 acres, of which 3,610 acres were classified as heavy timber.

A saw with a single blade has been adapted for use in cutting pine and cottonwood trees in the clearing of the reservoir area for the Bureau's Keyhole Dam on the Belle Fourche River near Moorcroft, Wyo. The blade in use here by the Lamb Construction Co. of Lusk, Wyo., is shorter and more adaptable to the terrain and cover at the reservoir site. Keyhole Reservoir will provide for the control of floods and for additional irrigation water for the Belle Fourche project in western South Dakota.

The Bureau will salvage from Boysen Reservoir 20,000 trees, 4 to 12 inches in diameter, to be used in its erosion-control program on Five Mile Creek which extends west from the upper end of the reservoir area. Because they have no commercial value, the rest of the cottonwoods will be burned with the brush. All heavy cover at the shore of the reservoir and all loose material from the middle of the reservoir area must be removed in order that the flotsam will not interfere with the operation of the dam and power plant or create hazards for the recreational use of the reservoir.

The control and conservation of the flows of the Bighorn River by Boysen Dam will indirectly make possible the eventual irrigation development of about 120,000 acres of land. The 72,000,000 kilowatt-hours of electrical energy to be generated annually at the 15,000-kilowatt Boysen Power Plant will help to relieve a critical power shortage in the Big Horn Basin. The development, which is a part of the Missouri River Basin project, also will provide for the control of floods and silt and the expansion of recreational possibilities and fish and wildlife habitat.

BURNING DEBRIS *after all usable timber has been salvaged, at left. Timber is no obstacle to this low-cutting, bulldozer mounted blade above, which clears 5 acres of dense timber in 8 hours.*

The lake formed by the 220-foot-high earthfill dam will cover an area of 19,660 acres and will have a normal operating pool of 820,000 acre-feet of water. Additional storage of 673,000 acre-feet will be provided for control of floods. Work on the 1,000-foot-long dam started in the Fall of 1947 and is scheduled to be completed this year. The power plant is expected to be in operation next spring. THE END

RECLAMATION UNDER MARSHALL PLAN

(Continued from page 137)

land from a raw state to a fully going concern. Such features are highways, farm centers (including churches, schools, post and telegraph offices, police stations, and other civil services), farm buildings, transmission lines, etc. Another essential difference in the two programs is that in the United States, water user's organizations, in general, must repay to the Federal Government the cost of reclamation works over a 40-year period without interest. The Italian program is based upon the premise that reclamation works are a national benefit and that the costs will be repaid

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the Government through taxes on the lands developed. Under the Italian law the Government contributes 87.5 percent of the cost of reclamation features to southern projects and 75 percent to northern projects, with local interests contributing 12.5 and 25 percent respectively. In the case of major features, such as construction of dams or river regulation, the Government pays the entire cost.

In view of these essential differences it was decided that every project would be carefully screened in order that the Mission could be assured that any given project would definitely contribute to the agricultural economy of Italy and to be certain that counterpart funds were being used only for projects which would compare favorably with reclamation projects selected for development in the United States. With this in mind a general criterion was established that only projects would be considered which would guarantee a maximum production of food in a minimum amount of time with a minimum amount of money. The Mission established a firm policy that no projects would be considered unless they were transmitted to the Mission by the Ministry of Agriculture. This made it possible to relieve the Mission immediately of the burden of discussing projects with pressure groups and individuals who had private interests or an "axe to grind," and made it possible for the Mission to devote its time exclusively to the examination of projects which had the approval and support of the Italian Government.

(See September 1951 issue for The Working Plan, part two in a three-part series.

KEEP YOUR EYE ON PELLETED SEED

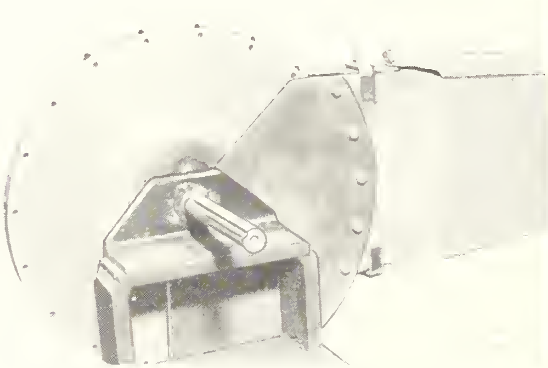
Four or five planting seasons ago, THE FURROW published a story on what was then an innovation in farming—the use of pelleted seed. The practice involves giving individual seeds, particularly the tiny, hard-to-handle ones, a coating to make them smooth, uniform in size and easier to handle. The idea promises now to catch on permanently, for at garden-planting time this year, the pellets could be purchased from many seed outlets.

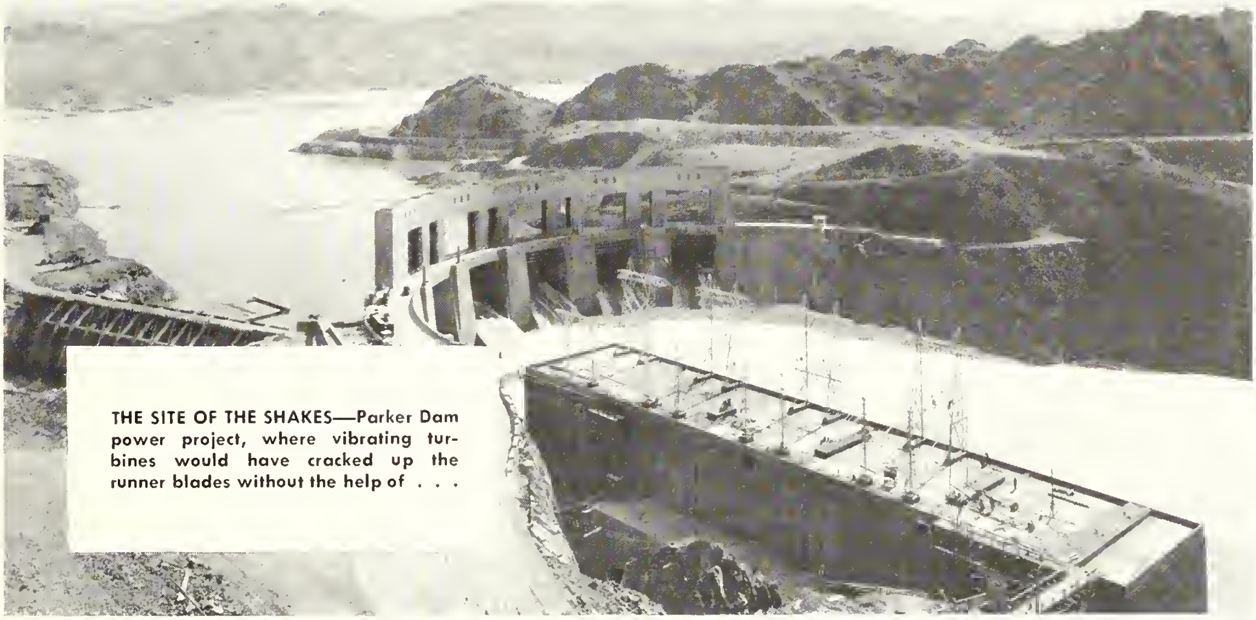
Among other advantages of pelleting are the savings in seed used, since the pellets can be spaced as plants are wanted in garden or field. This saves on thinning labor and costs. The inert, nontoxic coating material also is given a mite each of chemical fertilizer, fungicides, and synthetic hormones to speed growth.

Shown below, a machine that coats seed looks simple, on the outside, at least. It revolves like a cement mixer, agitating the seeds and spraying them with the mix. When processed, pelleted seeds resemble buckshot. Being smooth and uniform, they will feed through a drill more accurately than will unpelleted seeds, samples of which are also shown for comparison.

Commercial growers of such crops as tomatoes, carrots, and sugar beets use pelleted seed on a large scale. Looking ahead, it's something for all farmers and gardeners to keep an eye on. (Reprinted through the courtesy of Deere and Company, publishers of THE FURROW, from the August–September 1950 issue.)

ROUGH DIAMOND, *garden variety, receives automatic polishing, below. At right, pelleted and unpelleted seed. Photos courtesy of Deere and Company, publishers of The Furrow.*





THE SITE OF THE SHAKES—Parker Dam power project, where vibrating turbines would have cracked up the runner blades without the help of . . .

Photo taken by Phil Blew in 1942.

PARKER TROUBLE-SHOOTERS

by D. L. GOODMAN, Engineer, Branch of Design and Construction, Denver, Colorado

To Reclamation engineers it was all in the day's work, but to those unfamiliar with activities connected with the Bureau's power plants it was a dramatic story of 5 years of patience, perseverance and painstaking engineering which finally paid off.

It is a story of machines and men. The machines are the huge 60-ton turbines at the Parker Dam power project on the California-Arizona border. The men are a small group of trouble-shooting engineers who solved the stubborn and complex problem of vibrating turbines which threatened to shake themselves out of business.

The story began in 1946, 3 years after the four 40,000-horsepower (30,000-kilowatt) turbines had been completely installed in the Parker plant. By that time these spinning iron giants were vibrating so badly that the turbine runner blades were beginning to crack. In fact, if you had stood in the turbine pit at that time, you would have heard the syncopated beat of "arumph, arrumph, aarrumph" caused by 180 tons of water slamming against the blades every second. Under this steady vibrating action, the cracks gradually grew, spreading out on each of the four turbines' blades.

Unit No. 1, installed in December 1942, was the hardest hit. During the first major overhaul in the spring of 1946, when Bureau engineers investigated the extent of the damage, they found 14 out of the 15 runner blades to be seriously cracked near the top or crown of the turbine runner. In addition, the high velocity flow of water at subatmospheric pressures had pitted out critical areas of metal.

The first repairs made on Unit No. 1 and on the other three units at that time consisted of chipping out the cracked and pitted areas and partially filling the cavities with a soft steel welding material. The remainder of the pitted areas was then filled with stainless-steel rod, a metal highly resistive to the pitting action of the flowing water, and ground to the proper contour. However, these alterations did not eliminate the cause of the cracks, and within a short time they appeared again.

After this initial repair work, the engineers tried other techniques to correct the destructive shimmy. First they sharpened the leading edges of the runner blades by welding a ½-inch-square bar on the edge for the full length of the blade.

TROUBLE SHOOTERS AT WORK, directly below, fastening specialized instruments to runner blades. Farther down, the instruments "tuned in" on the Unit 1 runner (these two photos by Don H. Edwards). At center, below, one of the big 60-ton turbine runners being lifted from a freight car in October 1941 (*photo by Bertram S. Mack*). At extreme right, below, an idea of the extent of the cracking caused by vibration damage to one of the blades on Unit 1 turbine runner (*photo by George O. Bonawit*). Inset, artist Marie L. Lang's sketch of a Parker Power Plant turbine runner.

However, no significant reduction in the vibration was apparent.

Next they tried inserting round metal rods between adjacent blades on all four runners to reduce the vibration. But the rods merely transferred the force of the vibration and cracks grew where none had been before. Metal rods similarly placed on the trailing edge of the runner blades were equally ineffective.

The engineers then inserted 1-inch pipes, perforated with $\frac{1}{8}$-inch holes, into various parts of the runners, and pumped compressed air into strategic areas, hoping that the air would act as a cushion for the vibration. Although this cut down some of the noise, the runners continued to crack at a serious rate.

Later efforts included trimming the edges of the wicket gates (shutter-like mechanisms resembling venetian blinds which control the flow of water into the runners) and finally, as an emergency measure, completely rewelding the broken runners on the theory that the repair material would be considerably stronger than the original metal. Again, these efforts were of no avail, as the runners cracked in the same location about as rapidly as before.

To minimize the cracking, the powerhouse operators, in August 1948, were forced to restrict the flow of water to eight-tenths of the full gate open-

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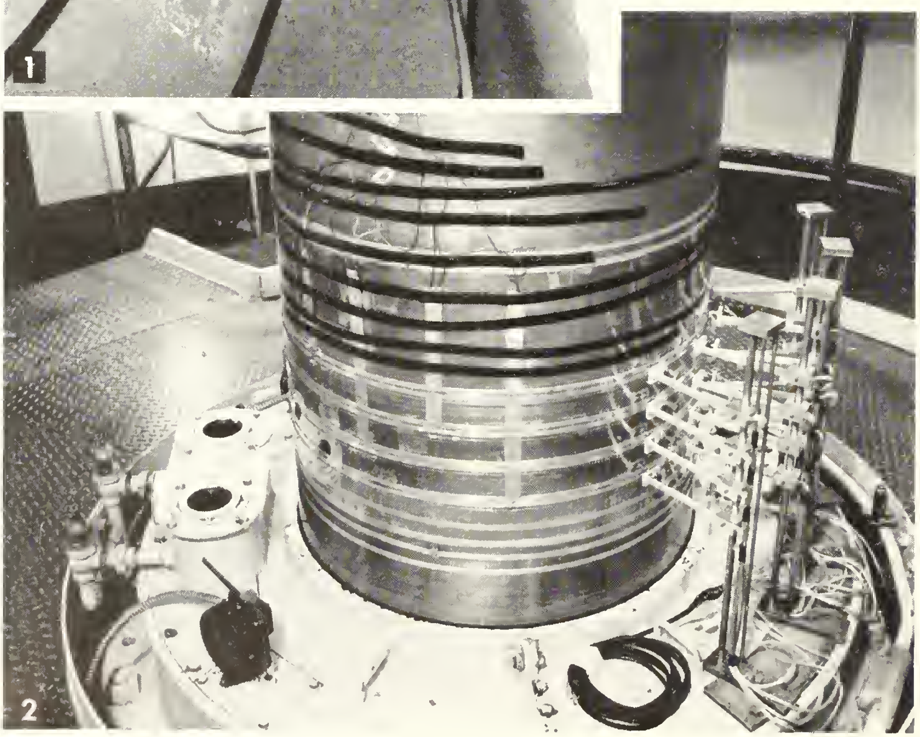

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ing. This limited gate opening condition existed until January of this year.

In the Spring of 1950 a small group of trouble-shooters arrived at Parker prepared to conduct exhaustive tests on the turbine's anatomy and ferret out the cause of the behavior of the turbine runners.

Armed with a variety of highly sensitive instruments, including such gadgets as oscillographs and special cells which measure pressure, strain, and acceleration, they descended into the bowels of the Unit No. 1 runner on the morning of Friday, April 14. Working against time, while the unit was shut down, these specialists rigged up an extensive network of the test apparatus throughout the turbine runner and adjacent areas. Every conceivable segment of the runner and related water passages was thus "tuned in" so that no area would escape attention under the vigilant diagnosticians' probing of the badly shaken runner body.

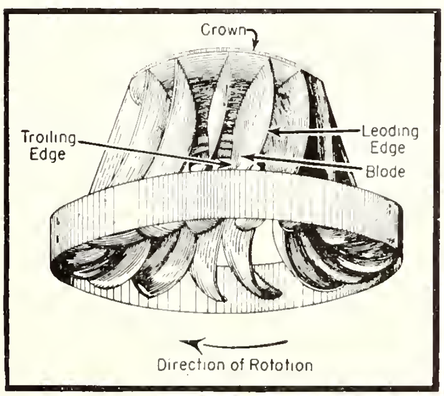
By 11:30 Sunday night, 50 hours later, the exhausted trouble-shooters climbed out of the draft tube (below the runner), their instruments tied into a collector placed on the turbine shaft in the pit above the runner. The turbine was then started up as soon as the water again flowed in the unit, and readings were carefully taken from all the instruments in operation below.

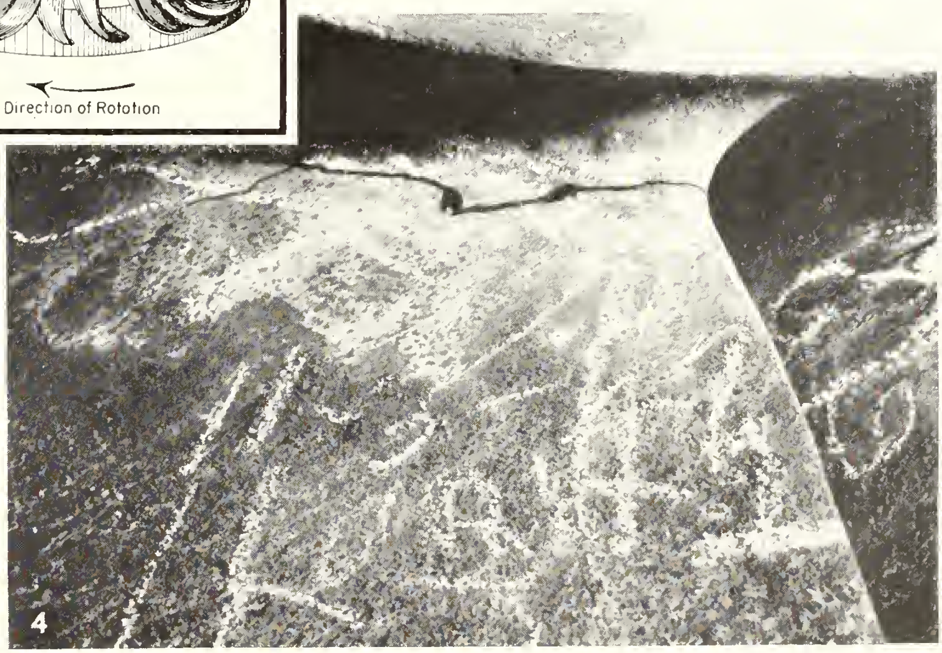
The data thus obtained showed conclusively that the only possible source of the trouble existed at the trailing edge (inside edge) of the runner blades. From this conclusive evidence which pin-pointed the source of the vibration, the trouble-shooters recommended that the trailing edges be sharpened, reducing the weight of each blade by 20 pounds. By thus modifying the trailing edge, the water could follow a smoother path in its descent through the runner—helping to minimize the vibration.

Alteration of the blades was sound from a theoretical viewpoint. By smoothing the approach surfaces and squaring the corners of the trailing edges, alternating pressures set up by zigzag eddies of water, known technically as vortex trails, were eliminated. Canceling out the eddies removed the forces which produced pressure changes which in turn induced vibration.

Following the engineers' recommendation for altering the blade edges, Unit No. 1 was shut down on October 25 last year, and round-the-clock work shifts began grinding the trailing edges along the entire lengths of the 15 blades of the runner. The work was completed by the morning of November 5. Modification of the remaining three units was scheduled to follow.

(Please turn to page 152)





MAIN ARTERY for Irrigation Block 40 in Grant County, Washington, is East Low Canal, above. *Photo by H. E. Foss, Region 1.*

Land of HEART'S DESIRE

by CLINT AMO, Land Settlement Specialist, Columbia Basin Project, Washington, Region 1 (Headquarters at Boise, Idaho)

This is the story of the first drawing in the northern part of the Columbia Basin project for 30 full-time farm units in Irrigation Block 40 in Grant County, Wash. This block of farms, to be served by the East Low Canal, includes farms from 49 to 125 acres each, located 75 miles south of Grand Coulee Dam, near three of the main project towns—Ephrata to the west, Moses Lake on the south and Soap Lake to the northwest. It represented the fourth such drawing for Columbia Basin project farms held by the Bureau of Reclamation.

It was poetic justice—not manipulation of the capsules—when pretty Mrs. Helen Bator became the first person in the audience to be announced as the holder of 1 of the low 30 priority numbers established at the public drawing in Moses Lake, Wash., on March 15, 1951.

With Mrs. Bator's excited acknowledgment of her name as a winner, the high-school band burst into a fanfare, and press and newsreel photographers happily concentrated on their attractive target.

Mrs. Bator was ushered to the stage where the Moses Lake Chamber of Commerce presented her with a "golden shovel" symbolic of the friendly and helping hand that was extended by the people of Moses Lake to the settlers who would soon be developing the nearby irrigated farms.

This was the climax to an impressive program cosponsored by the Moses Lake Chamber of Commerce and the Bureau of Reclamation, which featured talks by representatives of the city, State, and Nation. The speakers proclaimed that this moment represented the culmination of a cooperative effort that began long before the turning of the first dirt for the construction of Grand Coulee Dam.

Among the 400 people who attended the drawing were 10 persons who had submitted applications before the end of the simultaneous filing period on January 8, 1951. Three of these were

included in the first 30 names drawn. Since there were 30 farms offered by the United States, these 3 people were assured that they would receive further consideration by the Board of Examiners. Mrs. Bator, now a physical education instructor at Moses Lake High School, had actively helped her father during the war years of 1941 to 1945 with the various chores connected with the operation of his fruit ranch near Yakima, Wash. She applied as the spouse of a veteran of World War II when her husband was called back into active duty by the Navy.

The obvious joy that Mrs. Bator reflected as she received the news of the new opportunity offered her and her husband verified the belief of all those present that this was the land of heart's desire for many similar young families—the land where beauty never fades. THE END.

SYMBOL OF A GOLDEN FUTURE is this golden shovel presented to Mrs. Helen Bator by the Moses Lake Chamber of Commerce. Her name was drawn fifth for one of the Columbia Basin farms.

Radioactive Fertilizers

(Continued from page 135)

method is to use a 4-inch drill and place the phosphate in strips beside or around the plants. Phosphate at depths of 4 inches usually is most effective. This is called band placement, and often appears more effective than broadcast in relatively dry soil. In general, plants use (or recover) much more fertilizer phosphorus from soil which is kept moist through more frequent irrigations than from drier soil having fewer irrigations.

These are a few of the findings up to the present time. Research is being continued to obtain further verification of these findings. In addition, radioactive phosphorus is being used more and more to discover how much phosphorus is supplied by different soils, and to find out which crops can get the most out of soil phosphorus.

What's Ahead?

We must all recognize, however, that radiophosphorus is just one research tool—just one refinement in research techniques for one plant food. But it does help us to obtain information that previously was either impossible or difficult to get. Soil and plant scientists already are using other radioactive elements like zinc, iron, and calcium to find out more about these elements and how they behave in soils and plants. However, the soil problems before us in the irrigated West are many and varied and not all connected with plant nutrients. The problems on one soil are not necessarily the same as those on another soil. Varying climates and farming practices must be taken into consideration. We need many different research tools and much specialized know-how to solve these problems of making the most of our soil and water resources.

A small but industrious team of State and Federal researchers are pushing the job. This team is aided by such agencies as the Bureau of Reclamation and the Extension Service, and by commercial companies. They are trying to solve agricultural problems on both the older irrigated areas of the West and lands which are being, or are to be, brought under irrigation in the near future. The answers they get to these problems will take the gamble and guesswork out of farming and guarantee a profitable and stable agriculture for the Nation.

Thus, quietly and undramatically, more and more scientists are developing atomic energy for its intended purpose—to enrich, not destroy, mankind. THE END

Pasco's Prosperity Pattern

GONE ARE THE DAYS when farms abandoned for lack of water (as shown above) will be seen in this region—soon to be an irrigated paradise, and already demonstrating its possibilities.

by ROBERT O. ROGERS, Agricultural Economist, Columbia Basin Project, Region 1 (headquarters at Boise, Idaho)

THE PASCO PUMPING AREA OF THE COLUMBIA BASIN PROJECT, a tract of 5,400 acres of good quality land lying 10 miles northwest of Pasco, Wash., has been under irrigation during the past 3 years. It provides a practical demonstration of what may be expected with the development of the million acres of potentially irrigable land to be served by the project irrigation works.

Settlers on the Pasco Pumping Unit received one-half million dollars gross income from crops grown on 4,108 acres in 1950, an average of $122 per acre irrigated. Some crops, such as onions, sugar beets, and potatoes produced gross returns of over $260 and $340 per acre. In addition to revenue received from crops, some farmers have added to their returns by including livestock in their farm programs. Dairy herds are increasing in importance. Also beef cattle, hogs, and poultry are demanding interest. Several grade A dairies have been established which should ease the short milk supply in the Tri-City area, and operator returns have been good on thse ventures.

Of the million-acre Columbia Basin project, lands in the Pasco Pumping Unit, or Irrigation Block 1, were the first to receive water. About 38 percent of the land in the block is class 1, 36 percent is class 2, and 26 percent is class 3. The quality of land on this block is varied but on the whole it is slightly better than the project average. The growing season ranges from 140 to 170 days which compares favorably with the rest of the project.

Water was first delivered to farmers on the Pasco Pumping Unit on May 15, 1948. Although water became available late in the season, six units irrigated a total of 119 acres the first year. In 1949, the second year, 55 units were operated with 2,249 acres being irrigated. In 1950, the third year, 63 units were irrigated and 3,974 acres or 73 percent of the total acreage in the block was cropped.

In 1950, Pasco farmers used most of the acreage for dry red Mexican and Pinto beans, Kenland red clover seed, alfalfa hay, and potatoes. Crop yields have been good. Kenland red clover seed, includ-

ing first year plantings, averaged 200 pounds per acre in 1950 but yields of up to 800 pounds per acre have been obtained. Dry beans have been a very satisfactory crop, yielding an average of 32 bushels per acre, with yields running as high as 50 bushels per acre. Potatoes averaged 13 tons per acre but some operators made yields of 16 tons per acre. Alfalfa hay averaged about 3.6 tons per acre including cuttings from first year crops, and yields up to 9 tons per acre were made. Yields similar to these are expected on other blocks of the Columbia Basin project the first of which is to receive water beginning in 1952.

An example of a typical farm program on the better land class is provided on the farm of Mr. A. R. Thurman. His cropping pattern consists of 3 acres of field corn, 8 acres of Kenland red clover for seed, 7 acres of alfalfa hay, 11 acres of dry beans, 2 acres of early onions, 16 acres of early potatoes, 1 acre of rape for hog pasture, 5 acres of tame seeded pasture, and 2 acres of sudan grass. His livestock consisted of 11 dairy cows, 12 head of dairy young stock, 3 brood sows, 15 other hogs and a small number of chickens. To be successful, a farm program of this kind requires a good knowledge of farming and an investment ranging from $25,000 to $35,000. It is a well-diversified program and should provide good returns even in years when prices of one or two of the crops in the rotation are low.

A typical specialized farm on the Pasco Pumping Unit in 1950 had 43 acres of red Mexican beans and 20 acres of Kenland red clover for seed. The operator owned no livestock. The investment on farms similar to this one ranges from $15,000 to $25,000, depending upon the kind of house and whether or not the operator has a well for domestic water. In years of high prices for the crops grown on this farm the operators' return will be high but the chances of having some years of poor returns are much greater than on farms with the more diversified crop program. In 1950 the returns were poor for operators who specialized in late potatoes and onions or both. Some farms on the block were planted entirely to beans in 1950 and a few were planted entirely to either Kenland red clover or alfalfa for seed. Other crop rotations included one or more of the following crops: barley, corn, oats, wheat, clover seed, alfalfa seed, alfalfa hay, other hay, pasture lima beans, sweet corn, dry beans, onions, and potatoes.

PASCO PRODUCTS—This lush bean crop is typical of irrigated developed lands in the Pasco Pumping area of the Columbia Basin project only 3 years after the first water was delivered.

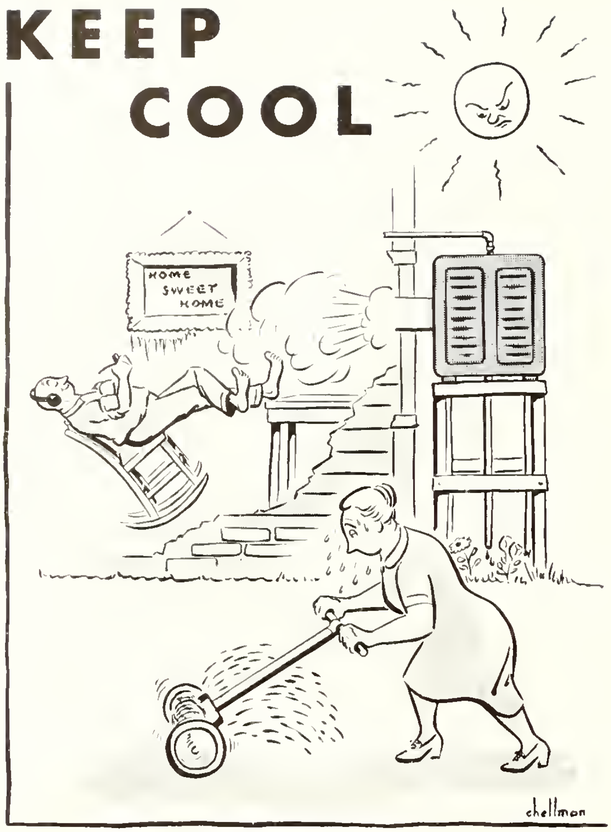
During the first years of development the irrigation blocks in the vicinity of Quincy, Moses Lake, and Othello are expected to have similar rates of development, enterprise patterns, crops, and crop yields. As the development period nears completion, more land is likely to be put into more permanent crops, such as asparagus, grapes, mint, hops, fruit, forage crops, and pasture. THE END

McClellan Receives Engineering Council's Gold Medal

Colorado's engineering profession paid the highest tribute at its command to the Bureau of Reclamation's Chief Engineer, L. N. McClellan, in Denver, Colo., on April 18, when the Colorado Engineering Council, made up of the local chapters of 20 professional societies, bestowed upon him the Gold Medal Award, acknowledging distinguished service in the field of engineering.

This award has been given only four times previously since it was originated in 1930. John L. Savage, formerly Chief Designing Engineer of the Bureau, being one of those so honored. •

KEEP COOL



WITH WATER IN THE WEST so valuable, each of its many uses is of great importance in water resource conservation and development. People living in areas more lavishly endowed with water may take such things as water-provided air-conditioning for granted, but in the West it is another of the many benefits of reclamation, worthy of serious consideration. ***Drawing by the Graphics Section, Washington, D. C., based on author's sketch.***

by D. A. DEDEL, Chief of Programs Section, Division of Programs and Finance, Region 3, Boulder City, Nev.

If you live in the arid Southwest, "keeping cool" is more than just a phrase to you—and you already know all about desert coolers. But if you live elsewhere in the Nation, you will be interested to learn how we of the desert manage to live very comfortably in summer temperatures of 95 to 110 degrees.

Several methods of mechanical cooling exist for use in offices or private dwellings. If you are wealthy enough to afford a refrigeration cooling system for your home, you are lucky; it is perhaps the best method of cooling available. But if you are a Government employee, a homesteader on a Reclamation project, or the like, you cannot afford the expenditure of $1,000 to $1,500 for your modest dwelling and by necessity will be forced to use the next best system—the evaporative type cooler.

If you remember your high school or college physics, you may recall an experiment in physics laboratory which was usually called the wet and dry bulb thermometer, or hygrometer, experiment.

The instrument you used consisted of two thermometers, one of which gave the true temperature of the air. The other thermometer, the bulb of which was covered with a wet cloth, gave a temperature that varied with the rate of evaporation of the water into the air. The drier the air, the greater was the evaporation from the wet bulb and the lower the temperature indicated by the second thermometer. When the air was saturated, there was no evaporation from the wet bulb, and both thermometers indicated the same temperature. Physics class is now dismissed!

Here is how that principle in physics is used in keeping cool at desert temperatures. Under normal summer temperatures, the percent of humidity is very low, ranging from 5 to 12 percent. The rate of evaporation is very high under such conditions; and, as the wet bulb physics experiment showed, a drop in temperature exists near a place where evaporation is taking place.

The early Pueblo Indians in this part of the country learned this principle, not from the study of physics but from experience. They covered the windows and doorways of their pueblos facing the direction of the prevailing winds with a porous blanket kept constantly wet. The hot winds, passing through the wet blanket, caused evaporation and dropped the temperature of air entering the interior of the pueblo by several degrees. We moderns, of course, must use a more convenient method—hence, we have the evaporative type cooler.

The modern cooler consists of a metal box measuring approximately 3 feet square and 3 feet high. Three of the cooler's vertical sides contain a series of horizontal louvers, or panels. The fourth side is solid except for an 18-inch square opening near the top, used as an air outlet. The top and bottom of the box are solid metal. Each of the vertical louvered sides is lined inside with an excelsior pad about 2 inches thick. This pad is kept constantly wet by a supply of water delivered through a small perforated pipe lying along the top of each excel-

sior pad. A large squirrel-cage rotary fan, operated by a 1/4- or 1/3-horsepower motor, is mounted inside of the box. The fan draws hot air through the wet excelsior, thus causing a high rate of evaporation, and cooling the air inside of the box so that the temperature drops between 20° and 25°.

The cooler can be placed in the window of a dwelling for direct delivery of cool air inside a room. Or, in a large installation, it can be placed on the roof, and the cooled air distributed by a duct system to all parts of the house.

For the average size dwelling, a cooler costing approximately $250 and delivering from 3,000 to 4,000 cubic feet of cool air per minute is used. So, when the temperature outside is bearing down at 100°, you can keep cool with 75 or 80 degrees inside. It's a household necessity. With apologies to a certain automobile manufacturer, "Ask the man who owns one." THE END.

Canals for Sacramento Valley

(Continued from page 139)

grown pasture and grain on 700 acres of fertile soil in Colusa County. He told a congressional committee, "one acre of irrigated land is equal to 5 acres of dry land. We have 40 percent increase in population which is additional expense to the community in the way of schools, transportation, and many other ways. This improvement would increase assessments, produce increased revenue, and provide employment for increased population."

Thomas B. Kees of Corning, Calif., county supervisor and chairman of the committee's Tehama County unit, has been producing and processing world famous California olives from his 65-acre grove for the past 25 years. He told Congress, "If our pumps decrease the water supply as fast in the next 15 years as they have in the past 10 years, we will have no water in our wells with which to irrigate our orchards and our small crops." He explained that the wells varied from 40 to 440 feet deep, with some 500-foot wells in some of the high locations. In reply to questioning by the congressional committee, he added, "Our water table is going down so fast that if we do not get some relief we will not have any water. We have a lot of valuable lands. For instance, I have an orchard, I do not mind telling you, for which I was offered $1,500 per acre. Without the water it is not worth $25 per acre."

P. V. Harrigan, secretary of the Glenn County unit of the Sacramento Valley Irrigation Committee, raiser of Ladino clover and livestock, told Congress, "For the past 10 years I have interested myself in attempting to bring water to a higher elevation than the present irrigation canals. After we worked out every avenue locally, you might say through private enterprise, it was found physically impossible to attempt a project of this kind because of the slope of the river, going through several counties." He cited the efforts made since 1866 to irrigate certain lands in the Sacramento Valley, and added, "Upon the completion of the Shasta Dam it was generally believed that a supporting canal system would be built. That is the thing we have been waiting for, for a number of years."

A. W. Bramwell, chairman of the committee's Butte County unit and a rice grower near Chico, also spoke before Congress, saying, "Water tables in Butte County from pumping are gradually receding. Water must be brought from the river for surface irrigation to continue to produce. This increase in valuation broadens the tax base, thereby assuring the early repayment of these improvements. As publisher of the Chico Enterprise-Record, I believe we interpret and reflect the opinion of our 35,000 readers, and we wholeheartedly support this project, as we believe it will be self-supporting and will pay back the cost in a reasonable length of time. We are asking your assistance in this investment. The canal project has met with the unanimous support of all the organizations of Butte County and particularly from other county, Farm Bureau and Grange Units. Committees from these organizations have worked with the chamber of commerce and our irrigation committee to gather material in support of this project. They have urged me to attend this hearing to present their case and are paying my expenses to Washington to do so."

And the enactment of Public Law 839 was the reward for 2 years of this kind of work. It was not easy. Oliver J. Carter, Chairman of the Democratic State Central Committee of California, now Federal Judge in San Francisco, wrote to the President of the United States offering his support for the legislation and said, "As far as I can determine, there is no opposition to the proposed bill. In fact, there is a militant organization of farmers and businessmen in the Sacramento Valley which is vigorously advocating passage of it. Companion bills have been introduced by Senators

Downey and Knowland and also Representative Hubert B. Scudder of the First Congressional District of California. You will be interested to know that the legislation is being advocated by a number of groups and individuals in California who have violently disagreed on some phases of the reclamation program. It is certainly significant that on these proposed features of the Central Valley project, there is unanimous approval and unanimity of opinion."

That was the key to our success. When we met at a Victory Dinner on October 12, 1950, James K. Carr, at that time District Manager for the Bureau of Reclamation's Sacramento Valley, summed up our activities when he said, "The recent approval by the Congress and President Truman of the Sacramento Valley Irrigation Canals, as a part of the Central Valley project, and the vision of new farms and new homes that will eventually be established in the Sacramento Valley when these canals are completed, certainly gives us good reason to rejoice—to celebrate—as we are doing on this memorable occasion." He stated another reason for jubilation, "we have been part of an outstanding example of cooperation between State and Federal agencies and the people of four California counties—we have witnessed an inspiring example of American democracy at work."

With this example before us, we shall continue working together until, as Charles Lambert of Willows said, "The upper Sacramento Valley is green from foothill to foothill, not just a fringe along the river." THE END

Parker Trouble Shooters

(Continued from page 145)

Observation of the unit after modification disclosed that the vibration set up by the vortex trails at the trailing edge of the runner blades had been completely eliminated. From the inspection, the engineers concluded there was no need for concern over possible increased erosion or pitting caused by the larger opening between blades—paint marks on the blades made during the tests in July were plainly undisturbed.

The payoff of this engineering success was threefold.

First, eliminating the vibration and thus stopping the cracking of the runner blades saved replacing them, at a cost of at least a half million dollars.

Second, the basic data derived from the tests and analyses are invaluable in establishing precedents for future designs of large turbine runners.

And third, of particular interest to those who use Parker plant's power, the output of the Parker turbines, resulting from streamlining the runner blades, has been increased by almost 5 percent, representing additional power for people in the area—power for pumping irrigation water, for turning the wheels of industry, and for the many labor-saving and comfort-giving devices which depend upon available electricity. THE END

Chapman Extends Deadline for Comments on Colorado River Storage Project

Secretary of the Interior Oscar L. Chapman extended the deadline for official comments on the proposed Colorado River Storage project and participating projects from May 15 to June 15. The extension was formally requested by the Upper Colorado River Commission and the States of Arizona, Colorado, and Utah. Only comments received so far are from Wyoming and Nevada. The States in the upper basin are Utah, Wyoming, Colorado, New Mexico, and Arizona.

The report outlines a program through which the five States in the upper basin can put to use their share of Colorado River water apportioned among them under the Upper Basin Compact. The report provides for storage of 48.5 million acre-feet of water in a series of 10 dams on the Upper Colorado and its tributaries, hydro power plants with an installed capacity of more than a million and a half kilowatts and irrigation for 2 million acres of land. •

Valley Division of Yuma Project To Be Taken Over by Water Users

The Yuma County Water Users' Association plans to take over operation of the Valley Division of the Yuma project by July 1 or as soon thereafter as is feasible. The actual take-over is expected to be gradual and members of the Association began to familiarize themselves with the duties performed by Reclamation Bureau personnel as early as April.

The first move in changing the Association into an operating agency was to hire Harry S. Riddell

of Delano, Calif., as manager. His background qualifies him adequately for the job, having served as city engineer in Susanville, Calif., and as project manager of the Southern San Joaquin Municipal Utility District. Under the reorganization the operation of the project will be divided into three divisions—watermaster, administrative, and maintenance—all under the jurisdiction of the project manager.

Power Plant Planned for Deer Creek Dam

Secretary of the Interior Oscar L. Chapman recently announced that the Bureau of Reclamation plans to build an 8,000-kilowatt capacity hydroelectric power plant at Deer Creek Dam on the Provo River project in Utah.

The Provo River Water Users Association, whose repayment contract provides for the construction of the plant either by the Bureau or the Association, has urged early construction. Secretary Chapman, in a letter to the Association's President, J. W. Gillman, pointed out that the Bureau of Reclamation had planned for the power plant and had already spent considerable money for the installation of a powerhouse substructure, penstocks, and other facilities to speed up the later installation of the power facilities.

However, the delay in starting construction was largely due to the uncertainty as to the final recommendations regarding the initial stage development of the Central Utah project with which the Deer Creek Reservoir must be coordinated for operation. The report on Central Utah has now been completed and submitted to the Colorado River Basin States for review, thus, removing one of the last major obstacles to construction of the Deer Creek power plant.

This power will provide a valuable resource from the defense standpoint and can be developed quickly with little capital investment as the majority of preliminary construction has been completed. Plans are being prepared for the installation of automatic, or semi-automatically operated, generating facilities at Deer Creek plant. As soon as the preliminary studies are completed Congress will be asked to provide for completion of the plant at the earliest practicable time. However, Secretary Chapman in his letter to Mr. Gillman said that he could not give any assurance as to the starting date of construction.

GOVERNOR ALLEN SHIVERS OF TEXAS signs the bill ratifying the Canadian River compact among Texas, Oklahoma, and New Mexico, on May 10, 1951, thus paving the way toward congressional approval of the tri-State compact and eventual construction of the Canadian River project (see article on page 48, March 1951 issue, *Reclamation Era*). Oklahoma and New Mexico governors had previously signed legislation approved by legislatures in those States so that the Bureau-planned and authorized 86-million-dollar project could provide municipal and industrial water supplies for 11 cities in the Panhandle-Plains area of Texas. Looking on as the Lone Star State's governor signs the compact bill are, left to right, Senator Grady Hazlewood, Representative Harold LaFonte, Senator K. B. Corbin, A. A. Meredith, city manager of Borger, Tex., and E. V. Spence, former chairman of the Texas Board of Water Engineers. *Photo by Neal Douglass, Austin, Tex.*

Salt Lake Aqueduct in Operation

On May 1, 1951, Salt Lake City's Metropolitan Water District assumed operation and maintenance of the Salt Lake Aqueduct, a 41-mile pipeline which is the principal feature of the Aqueduct Division of the Provo River project, and represents one of the first instances in Bureau history wherein an irrigation project was extended to supply municipalities with water currently in excess of project irrigation needs.

The Provo River project also supplies domestic water to six other municipalities, including Provo, in addition to furnishing a supplemental water supply for irrigating about 46,000 acres of highly productive farm lands in Salt Lake and Utah Counties.

Until the terminal reservoir is completed (scheduled for December 1951) the Aqueduct can be operated in three different ways: (1) bypassing the terminal reservoir and discharging into the existing Samuel C. Park Reservoir; (2) bypassing Park Reservoir and discharging directly into the City's feeder main; or (3) spilling into Parley's Creek via an emergency overflow structure and wasteway conduit.

BUREAU RELEASES THREE NEW MOTION PICTURE FILMS

Three half-hour 16-millimeter motion pictures have recently been released by the Bureau of Reclamation as visual educational aids. Corralling the Colorado has already been seen on the Nation's television screens, both in the East and the West. This black and white film, with sound, contains some of the famous footage showing the construction of Hoover Dam. Water in the West, another black and white film, will be released this summer. A color film, Weed Control on Irrigation Systems, has just been completed, and shows the problems of weed control and the most recent developments in weed-control methods and equipment. While the film was designed primarily for the benefit of operating personnel—boards of directors, irrigation superintendents and managers, watermasters, ditch-riders and maintenance crews—it should be of interest to project farmers as well. It will be used by many high schools and colleges where agricultural and irrigation courses are taught. In addition to the motion picture, a slide lecture of colored slides has also been released on the same subject, for use where 16-millimeter sound projection equipment is not available.

All three of the films may be obtained from Bureau of Reclamation Regional Directors (see directory on the inside back page of this issue) or from the Commissioner, Bureau of Reclamation, Washington 25, D. C. No rental charges are made for the use of the films or slides, and the only cost to the borrower is for transportation from, and return to, the office from which they are obtained. ●

WATER REPORT

The irrigation water forecast as of ıne 1 remained about the same as that r last month. Farmers can look for enerally adequate to plentiful water ıpplies throughout the seventeen Vestern States except in the Southwest. rrigation water will be in short supy in the San Joaquin Basin, and exremely short in the Salt River and io Grande basins. Floods of record reaking size occurred in Oklahoma and 'ansas during the month of May. lood stages were reached on several reams in northern Utah, and Great alt Lake recorded its highest elevation nce 1931. Tributary runoff was genrally excessive in the Columbia River asin but the peak flow at The Dalles 'as below normal, so that there is little r no likelihood of disastrous floods this pring. Severe drought persisted in the outhwest, particularly in western New Iexico. Many farmers of the Rio rande project are drilling wells to btain supplemental irrigation water, nce the depleted storage supply for ie project is being strictly rationed.

By regions, the situation is as follows:

Region 1—outlook is generally exllent. Last month we reported that ie tributary watershed of the Yakima oject had experienced the driest pril of record. In May, the situation as reversed, with precipitation over te area averaging 175% of normal. he Yakima project reservoirs were terefore used for flood control during te month, and were all practically fed on June 1. The first pump units pmping water from Franklin D. Roosevt Lake into the Grande Coulee Equaling Reservoir were put into service dring the month.

Region 2—inflow to Shasta Lake dring May was 111% of normal. As a esult, the reservoir reached a maximm stage of record on May 26 with aive storage of 3,914,500 acre-feet. In ctrast, inflow into Millerton Lake dring the month was only 68% of nmal.

Region 3—storage in Lake Mead was afcted by the fact that snow runoff in th upper Colorado River Basin was abut one month later than normal. As a sult, Lake Mead reached a minimum elation for this year on May 11 (elevaon 1149.19; active storage 16,483,000 acre-feet). This is the latest annual minimum for Lake Mead since original filling of the reservoir. The drought abated slightly in Arizona with some precipitation occurring over the Verde River watershed. There was no appreciable inflow, however, into any of the Salt River project reservoirs, where water supply conditions remain critical.

Region 4—floods occurred in northern Utah, while in southern Utah and southwestern Colorado, the drought continued with little relief. It is anticipated that irrigation water supplies will be sufficient for production of normal crops on all Bureau projects within the region, although on the Pine River project in southwestern Colorado this will be accomplished only through rationing of the available storage supply from Vallecito Reservoir and strict observance of conservation measures by the water users.

Region 5—as a result of heavy precipitation in Oklahoma during May, the Altus Reservoir of the W. C. Austin project filled to overflowing. There was slight relief from the drought in northeastern New Mexico but no relief at all in the Rio Grande Valley in western New Mexico and Texas. Storage in reservoirs of the Rio Grande project at the end of May set another new record low.

Region 6—irrigation prospects are very good on all except the Belle Fourche project in South Dakota where stream flows into the Belle Fourche Reservoir have continued below normal.

Region 7—all reservoirs are well-filled and irrigation prospects are from good to excellent. ●

CROPS

Reclamation Crops Exceed 13 Million Tons

Reclamation farms through the 17 western States produced more than 13 million tons of crops, worth more than one-half billion dollars, last year.

These farms totaling about 5 million acres were all served in whole or part by water from Reclamation facilities. Latest figures show that the Bureau furnished water for the first time to 275,546 acres of full- and part-time farms during 1950. The Central Valley project in Region 2 in the State of California ranked first in the amount of irrigated lands, with 2,145 farms totaling 172,205 acres receiving an initial supplemental water supply during the year.

New acreages being served for the first time during 1950 included 29,211 in Region 1; 10,381 in Region 3; 11,901 in Region 4; 31,563 in Region 5; 18,572 in Region 6, and 1,713 in Region 7. ●

LETTERS

Overseas Interest

Seidenstrasse, Vienna, Austria,
March 9, 1951.

To United States Bureau of Reclamation, Denver, Colo.

In our fortnightly magazine "Landwirtschaftliche Machrichten aus den Vereinigten Staaten" (Agricultural News from the United States), edited by the United States Commission for Austria, we published an article about the new clay analysis worked out by scientists of the United States Bureau of Reclamation at Denver, Colo. As a source for the article which appeared in issue No. 97 of February 1, 1951, we used a State Department press release from Washington, D. C.

High interest in the new method was raised by this article in competent Austrian circles. We therefore ask whether you would be able to send us more detailed information about this analysis, including, perhaps, photos or drawings.

For your information we add to this letter a copy of the press release used by us (in English) as well as the issue of our magazine in which the article appeared (in German).

Yours very truly,

Carl H. Peterson,
Press Officer.

(The Bureau's Denver, Colo., office received the above letter along with numerous other requests for additional information on this subject which leads us to believe that D. L. Goodman's article, "Color Tests for Clay" which appeared in the November 1950 issue ef the Reclamation Era has stimulated widespread interest in the work of the Bureau of Reclamation.—Ed.)

Asia Earthquake Affects Texas Water Wells

The Geological Survey reports that water wells in Texas and Florida rose and fell in relation to the earthquake tremors in Burma, China, and Tibet last August. This seems to substantiate the theory that the earth is a single geological unit. ●

NOTES FOR CONTRACTORS

Contracts Awarded During May 1951

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DS-3240	Central Valley, Calif.	May 28	10 turbine-type and 2 centrifugal-type pumping units for Trauger pumping plant, Lindsay-Strathmore irrigation district, Friant-Kern canal distribution system.	Food Machinery and Chemical Corp., Los Angeles, Calif.	$132,30
DC-3295	Eklutna, Alaska	May 7	Erecting 142-foot by 55-foot steel warehouse building for Eklutna government camp.	Sandvik, Roark and Ray F. James, Palmer, Alaska.	76,59
DS-3297	Missouri River Basin, Wyo.-Mont.	May 24	2 portable oil purifiers and 2 filter-paper drying ovens for Boysen and Canyon Ferry power plants.	De Laval Separator Co., Chicago, Ill.	15,24
DC-3326	Boise, Idaho	May 29	Construction of 2.2 miles of 4.16-kilovolt transmission line and an electrical distribution system, and conversion of coal-fired furnaces to electrically heated furnaces for Anderson Ranch government camp.	American Electric Co., Caldwell, Idaho.	54,70
DC-3331	Colorado-Big Thompson, Colo.	May 18	Construction of North Poudre supply canal diversion dam, canal headworks, tunnels, and siphons, schedules 1, 3, 4, and 5.	G. L. Tarlton Contracting Co., St. Louis, Mo.	1,955,18
DC-3331	do	do	Construction of North Poudre supply canal, schedule 6	Adler Construction Co., Loveland, Colo.	756,45
DS-3335	Missouri River Basin, N. Dak.	May 21	4 controlling and 9 controlled station supervisory control and telemetering switchboard sections and associated equipment for Jamestown, Carrington, Devils Lake, Leeds, Rugby, Lakota, Edgeley, Forman, Bismarck, and Valley City substations, Central North Dakota power system.	Control Corp., Minneapolis, Minn.	83,61
DC-3337	Klamath, Oreg.-Calif.	May 16	Construction of earthwork and structures for lower Lost River channel improvement; North Main dike; strengthening dikes on Tulelake sump; bank reconstruction of N canal; and reconstruction of oultet works from pumping plant No. 5.	George R. Stacy, Tulelake, Calif.	380,20
DS-3342	Hungry Horse, Mont.	May 2	1 lot of metalwork for elevator towers and block 14 elevator shaft, Hungry Horse Dam.	Arrow Iron and Machine Works, Seattle, Wash.	15,90
DS-3344	Central Valley, Calif.	May 14	Three 74,000-horsepower hydraulic turbines for Folsom power plant.	Newport News Shipbuilding and Dry Dock Co., Newport News, Va.	1,629,62
DS-3345	Hungry Horse, Mont.	May 7	Spiral and inclined stairs for galleries, Hungry Horse Dam.	Nelleo Products, Hollydale, Calif.	34,25
DS-3351	Colorado-Big Thompson, Colo.	May 21	Three 115,000-volt circuit breakers and eighteen 115,000-volt disconnecting switches for Flatiron and Pole Hill switchyards.	Pacific Electric Mfg. Corp., San Francisco, Calif.	123,58
DS-3355	Davis Dam, Ariz.	May 23	One 1,000 kilovolt-ampere unit substation for Phoenix substation.	Gough Industries, Inc., Los Angeles, Calif.	24,49
DC-3358	Cachuma, Calif.	May 3	Furnishing and installing 1 electric freight elevator for Tecolote tunnel.	Kimball Elevator Co., Ltd., Los Angeles, Calif.	16,48
DS-3360	Columbia Basin, Wash.	May 18	Structural steel for Chicago, Milwaukee, St. Paul & Pacific railroad bridge at Potholes East canal.	American Bridge Co., Denver, Colo.	19,00
DS-3365	Missouri River Basin, Mont.	May 29	4 radial-gate hoists for spillway at Canyon Ferry Dam	Monarch Forge and Machine Works, Portland, Oreg.	71,83
DC-3368	Columbia Basin, Wash.	May 11	Construction of 70-foot by 150-foot machine shop building for Operation and Maintenance headquarters at Othello, Wash.	Cherf Bros. Construction Co., Ephrata, Wash.	124,09
DC-3369	Colorado River Front and Levee System, Ariz.-Calif.-Nev.	May 21	Construction of earthwork and structures for Yuma Levee, Lower Colorado River district.	Gibbons and Reed Co., Salt Lake City, Utah.	1,021,92
DC-3371	Grand Valley, Colo.	May 9	Construction of East Salt and Badger wash siphons and check on Highline canal, and siphon on lateral 21 AC.	Ross Construction Co., Provo, Utah.	206,98
DC-3372	Missouri River Basin, S. Dak.	May 29	Construction of 92.3 miles of Angostura canal, wasteways, laterals, sublaterals, and surface drains.	Peter Kiewit Sons' Co., Omaha, Nebr.	2,212,50
DS-3374	Rio Grande, N. Mex.	do	Supervisory control equipment for Albuquerque, Belen, Central, and Las Cruces substations, Las Cruces switching station, and Elephant Butte power plant, schedule 2.	Control Corp., Minneapolis, Minn.	27,20
DS-3377	Cachuma, Calif.	May 11	Structural steel for access bridge, Tecolote tunnel intake tower	California Steel Products Co., Richmond, Calif.	15,09
DC-3378	Missouri River Basin, Wyo.	May 3	Contraction joint grouting of Kortes Dam	C. M. Hanes Construction Co., Denver, Colo.	12,42
DC-3380	Kendrick, Wyo.	May 18	Construction of Sinclair-Hanna 34.5-kilovolt transmission line	Sturgeon Electric Co., Inc., Denver, Colo.	84,86
DC-3433	Colorado-Big Thompson, Colo.	May 23	Drilling and grouting foundations for dikes Nos. 1 and 2, Granby dam and dikes.	Jones Core Drilling Co., Dallas, Tex.	64,66
117C-100	Columbia Basin, Wash.	May 7	Construction of Watermaster Office Bldg., storehouse, garages, and general purpose shop at O. & M. Headquarters, Winchester, Wash.	W. J. Park & Sons, Yakima, Wash.	95,28
200C-155	Central Valley, Calif.	May 9	Street and utility improvement and Imhoff tank at Toyon Government camp.	Tyson & Watters, Inc., Sacramento, Calif.	112,67
300C-12	Davis Dam, Ariz.-Nev.	May 2	Construction of Knob substation	Arrow Construction Co., Yuma, Ariz.	77,28
300C-20	do	May 14	Construction of operator's house at Tucson substation	Leonard Daily, Tucson, Ariz.	15,47
400C-26	Grand Valley, Colo.	May 28	Earthwork and channel slope protection in Big Salt Wash	Colorado Constructors, Denver, Colo.	15,28
604C-22	Missouri River Basin, Mont.	May 7	Clearing areas 3 and 4 of Canyon Ferry Reservoir	Thompson-Kirkwood Co., Billings, Mont.	19,87
704C-181	Colorado-Big Thompson, Colo.	May 10	Landscaping Estes Power Plant	Southwest Contracting Co., Florence, Colo.	12,38

Construction and Materials for Which Bids Will Be Requested by September 1951

Project	Description of work or material
Boise, Idaho	Two 7,200-volt circuit breakers for Anderson Ranch power plant.
Cachuma, Calif.	Construction of 12 miles of 36- to 27-inch diameter concrete pipe conduit for part of the Carpinteria section of the South Coast conduit near Santa Barbara, Calif.
Central Valley, Calif.	Construction of 25 miles of 12- to 36-inch diameter concrete irrigation pipe lines for the Stone-Corral irrigation district, Friant-Kern canal distribution system, near Seville, Calif.
Do	Construction of 115- and 69-kilovolt switchyard extension at Tracy switchyard.

Construction and Materials for Which Bids Will Be Requested by September 1951—Continued

Project	Description of work or material
Central Valley, Calif.	Erection of two prefabricated metal buildings with concrete floors to store transmission line materials and equipment at Elverta and Orland, Calif.
Do	One 20,000-kilovolt-ampere and two 5,000/6,250-kilovolt-ampere transformers for Folsom power plant.
Colorado-Big Thompson, Colo.	Clearing trees and brush in Willow Creek reservoir and south side access road, 6 miles north of Granby, Colo.
Do	Installing electrical equipment in Green Mountain switchyard addition, near Kremmling, Colo.
Columbia Basin, Wash.	Construction of 59 miles of laterals and wasteways in lateral area P-1, Potholes East canal, near Othello, Wash.
Do	Construction of 17 miles of unlined laterals in lateral area P-2, Potholes East canal, near Othello, Wash.
Do	Construction of wasteways for laterals EL-16 and EL-18 in lateral area E-1, East Low canal, near Moses Lake, Wash.
Do	Construction of 85 miles of unlined laterals and wasteways for lateral area W-5, West canal, near Winchester, Wash.
Do	Construction of a 650-foot unlined wasteway turnout from West canal, with stop-log overflow section and two 6- by 5-foot slide gates and hoists, 6 miles south of Quincy, Wash.
Do	Construction of two 35 cubic-foot-per-second capacity pumping plants near Soap Lake, Wash.
Do	Construction of Lower Scooteney pumping plant (PE-27), 76 cubic-foot-per-second total capacity at 149-foot total discharge head; and Upper Scooteney pumping plant (PE-27A), 24 cubic-foot-per-second total capacity at 97-foot total discharge head, and 2,200 feet of unlined lateral.
Do	Construction of office building, general purpose shop, warehouse, two garages, and eight residences with unattached garages at Eltopia, Wash.
Do	Completion of electrical wiring for underground distribution system in industrial area and removal of existing overhead distribution system; construction of heating plant substation and electrical installation in heating plant; removal of existing heating plant; installation of substation for caisson drydock; and revisions to distribution line to North Coulee Dam, all at Coulee Dam, Wash.
Do	Furnishing and installing chain-link fencing along section of feeder canal and for fuel storage plant in industrial area at Coulee Dam, Wash.
Davis Dam, Ariz.-Nev.	Erection of steel structures and installation of electrical equipment for 20,000-kilovolt-ampere Cochise substation.
Do	Main control board for Prescott substation.
Eklutna, Alaska	Two 16,667-kilovolt-ampere vertical-shaft generators for Eklutna power plant.
Gila, Ariz.	Construction of 28 miles of unreinforced concrete-lined Mohawk laterals and sublaterals, Unit 1, and appurtenant reinforced concrete structures near Roll, Ariz.
Kendrick, Wyo.	Construction of 36 miles of 34.5-kilovolt transmission line between Seminoe dam and Bairoil, Wyo.
Do	Construction of 35 miles of double-circuit telephone line from new Casper substation to Alcova dam, Wyo.
Do	Construction of sidewalks, 1 mile of streets, and sewage and water systems near Alcova Dam.
Do	Construction of 12 two-bedroom houses at Alcova Dam.
Minidoka, Idaho	Three 11,100-kilovolt-ampere generators for American Falls power plant.
Missouri River Basin and Fort Peck, Mont.	Moving temporary houses, trailer houses, office and warehouse to Tiber dam government camp; constructing foundations and connecting utilities. Moving a house 60 miles to Havre substation near Havre, Mont., and placing on previously constructed foundation.
Missouri River Basin, Nebr.	Construction of 11 miles of unlined and 2 miles of concrete lined reaches of Courtland canal, near Superior, Nebr.
Missouri River Basin, N. Dak.	Construction of 1,500-kilovolt-ampere Custer Trail substation, near Bismarck, N. Dak.
	Construction of 2,500-kilovolt-ampere DeVaul substation, 11 miles southeast of Almont, N. Dak.
Missouri River Basin, S. Dak.	Construction of Huron, Watertown, Sioux Falls, and Mount Vernon 115-kilovolt substations.
Do	Construction of 25,000-kilovolt-ampere Brookings substation.
Do	Construction of 15,000-kilovolt-ampere Lone Tree substation.
Do	First stage construction of 10,000-kilovolt-ampere Woonsocket substation.
Do	Moving two houses from Bixby government camp to Angostura dam site camp, erection of houses and construction of utilities.
Missouri River Basin, Wyo.	Relocation of Chicago and Northwestern railroad and telegraph line along Boysen reservoir, near Riverton, Wyo.
Do	Construction of 2,000 feet of Alcova switchyard road, 32 miles southwest of Casper, Wyo.
Do	Exploratory drilling at dam sites, tunnels, and other major structures in the Wind and Clarks Forks divisions and Shoshone extensions unit of Missouri River Basin project in Fremont, Park, Big Horn, and Hot Springs counties, Wyo.
Rio Grande, N. Mex.	Construction of 20 miles of Rio Grande River drainage and conveyance channel and levee above Elephant Butte reservoir.
San Luis Valley, Colo.	Construction of operating road at Platoro dam site 35 miles northwest of Antonito, Colo.

United States Department of the Interior
Oscar L. Chapman, Secretary
BUREAU OF RECLAMATION OFFICES

Washington Office: United States Department of the Interior, Bureau of Reclamation, Washington 25, D. C.

Commissioner's Staff

Commissioner	Michael W. Straus
Assistant Commissioner	Kenneth Markwell
Assistant Commissioner	Wesley R. Nelson
Assistant Commissioner	Goodrich W. Lineweaver
Assistant to the Commissioner—Engineering	T. W. Mermel
Assistant to the Commissioner—Management	G. S. Ellsworth
Chief Counsel	Edward W. Fisher
Chief Engineer, and Director, Branch of Design and Construction, Denver, Colo.	L. N. McClellan
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Chief Personnel Officer	Glenn D. Thompson
Comptroller	W. Darlington Denit
Director, Branch of Operation and Maintenance	E. D. Eaton
Director, Branch of Power Utilization	Harvey F. McPhail
Director, Branch of Project Planning	John W. Dixon
Director of Programs and Finance	Alfred R. Golze
Director of Supply	S. W. Crosthwait
District Manager, Alaska District Office, Juneau, Alaska	Joseph M. Morgan
Chief, United Western Investigations, 222 South West Temple, Salt Lake City, Utah	Stanford P. McCasland

REGIONAL OFFICES

REGION 1: Harold T. Nelson, Regional Director, Box 937, Reclamation Building, Fairgrounds, Boise, Idaho.
REGION 2: R. L. Boke, Regional Director, Box, 2511 Old Post Office Building, Sacramento 10, Calif.
REGION 3: E. A. Moritz, Regional Director, Administration Building, Boulder City, Nev.
REGION 4: E. O. Larson, Regional Director, 32 Exchange Place, P. O. Box 360, Salt Lake City 8, Utah.
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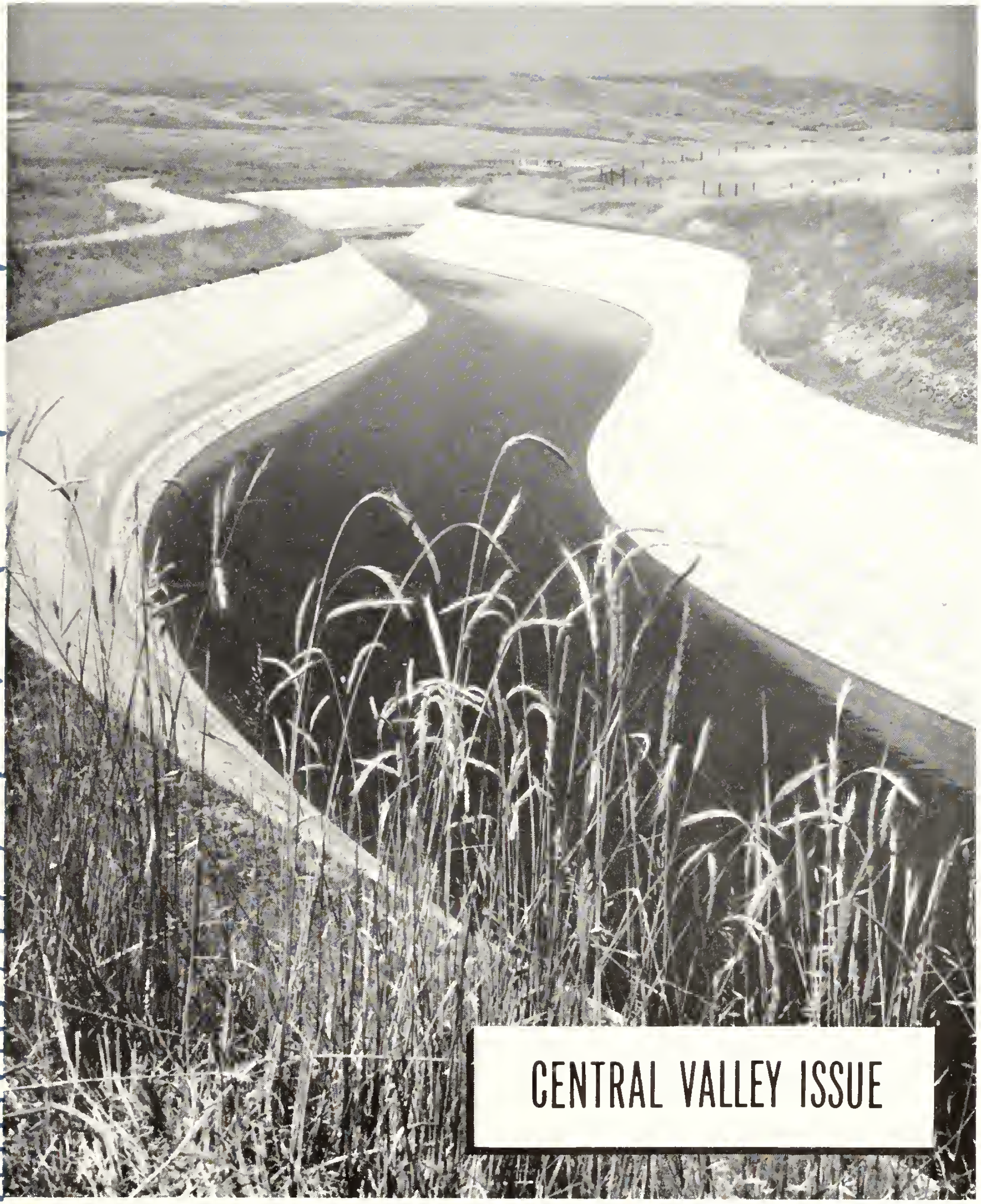
THE RECLAMATION AREA

The Reclamation ERA

August

1951



CENTRAL VALLEY ISSUE

Official Publication of the Bureau of Reclamation

The Reclamation ERA

August 1951
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Ruth F. Sadler, *Editor*

Subscription rate $1.50 a year for persons residing in the United States and Canada; $2 a year for foreign subscriptions; special rate of $1 a year for members of water users' associations, and Bureau of Reclamation employees.

OUR FRONT COVER

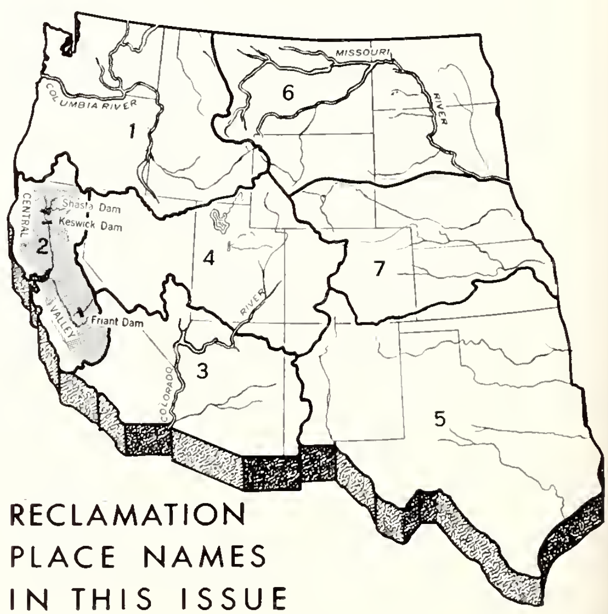
"for amber waves of grain"

America's beauty and bounty, its productivity and opportunity, are exemplified in this photo by Region 2's Chief Photographer Ben Glaha showing the Friant Kern Canal flowing past a field of golden grain. As the Central Valley project goes into full integrated operation this month, the Friant Kern Canal, a 60 million dollar man-made river, will carry water 153 miles from Madera to Kern county—and some of the 15-foot-deep flow will be made up of Sacramento River water, lifted over the Delta by the gigantic Tracy Pumping Plant, which transfers life-giving water from one river basin to another.

30 YEARS AGO IN THE ERA

Recovery has been halted by the continuance of strife in all the great foreign market centers. Our abundant surplus crops have moved out slowly and at diminishing prices. Taxes of every imaginable sort have been imposed until the burden of the people is staggering. The farmer suffered most because he was hit first. The prices for what he had to sell fell sharply long before there was any appreciable drop in what he had to buy. Slowly the equilibrium began to be restored. The balance is still on the wrong side because of the failure of the retailer to take his loss on his stocks purchased at war prices. He is still forgetful of the fact that he sold his prewar stock at war prices, and that it is but fair for him to accept a loss on present stocks in order to more quickly bring about a readjustment of conditions.

(From the August 1921 issue of the Reclamation Record, predecessor to the Reclamation Era.)



RECLAMATION PLACE NAMES IN THIS ISSUE

SENATE CONCURRENT RESOLUTION NO. 47

Relative to the Central Valley Project

INTRODUCED by Senators Jesse M. Mayo, Harold T. Johnson, George Miller, Jr., Jess R. Dorsey, Gerald O'Gara, Roy Cunningham, Hugh P. Donnelly, Verne W. Hoffman, George J. Hatfield, Arthur H. Breed, Nathan F. Coombs, Ed. C. Johnson, H. E. Dillinger, Harold J. Powers, Earl D. Desmond and Hugh M. Burns of the California Legislature.

WHEREAS, In seeking to bring about the fullest development of the waters of our State for beneficial uses, the Legislature, nearly 20 years ago, authorized the Central Valley project to provide for the collection and transfer of a portion of the plentiful waters in the northern part of the Central Valley for distribution in parched lands in the southern portion of the valley; and

WHEREAS, On August 1, 1951, the first water destined to be transferred from Sacramento Valley to San Joaquin Valley, will be spilled from the Shasta Dam; and

WHEREAS, This transfer of water marks the first integrated operation of the initial features of the Central Valley project; and

WHEREAS, The water so released on August 1, will flow, during a 10-day period, through the Sacramento River, the Sacramento Delta, through the Cross Channel to Tracy, and through the Delta-Mendota Canal 120 miles to the Mendota Pool to replace water that would normally flow down the San Joaquin River and permit the diversion of that water at Friant Dam through the Friant-Kern Canal to the Kern River at Bakersfield; and

WHEREAS, The magnitude of the works necessary to accomplish the transfer of water is evidenced by the six 22,500 horsepower pumps at the Tracy pumping plant which will lift the water 200 feet at the rate of 2,000,000 gallons a minute; and

WHEREAS, The Central Valley project, constructed by the Federal Bureau of Reclamation, will provide water over 1,000,000 acres of land in the San Joaquin Valley which, for many years, has been suffering from an extreme water shortage, it containing two-thirds of the arid lands in the State and having only one-third of the water supply; and

WHEREAS, Many communities throughout the 500-mile length of the valley served by the project plan to hold celebrations in observance of the first transfer of waters; now, therefore, be it

Resolved by the Senate of the State of California, the Assembly thereof concurring, That the Legislature respectfully requests the Governor to proclaim, as the Central Valley Water Festival, a 10-day period of observance of the celebration of the completion of the initial features of the Central Valley project from August 1, 1951, through August 10, 1951; and be it further

Resolved, That the Secretary of the Senate is directed to transmit a copy of this resolution to the Governor of this State. •

WHEN GOOD VALLEYS GET TOGETHER the result is prize-winning asparagus and prize Holstein bulls, like the one below, raised in an area served by the Madera Canal, one of the arteries of the now-joined Sacramento and San Joaquin Valleys of the CVP.

CREATED FOR SERVICE

by

TOM HENNION, Editor

Tulare Advance Register, Tulare, Calif.

TO FULLY UNDERSTAND THE CENTRAL VALLEY PROJECT, you must first understand the amazing valley it was created to serve.

The Central Valley actually is not one valley but two—the Sacramento and the San Joaquin—which roll for mile after endless mile through the very heart of California's great agricultural empire.

The watersheds of the two valleys combined make up the Central Valley basin. The combined watersheds extend nearly 500 miles in a northwest-southeast direction, and average about 120 miles in width. The basin is entirely surrounded by mountains except for a gap in the western edge.

The valley floor occupies about one-third of the basin. The other two-thirds is mountainous country. The Sierra Nevada Mountains rise on the east to more than 14,000 feet in elevation. The coast range on the west reaches elevations as high as 8,000 feet.

The Sacramento River with its tributaries flows southward and drains the northern part of the basin. The San Joaquin River with its tributaries flows northward and drains the southern portion.

These two river systems join at the Sacramento-San Joaquin delta near Stockton to find a common outlet through a gap in the coast range into San Francisco Bay and then into the Pacific Ocean. If it weren't for the Central Valley project, these waters would continue to be (as they have in the past) mainly wasted into the ocean, lost forever.

The Central Valley supports 1,500,000 people in its cities and towns and on its farmlands. Agriculture is the predominant industry. And agriculture demands water.

The Central Valley project was designed to provide that water, or rather to rearrange the distribution of water so that the bulk of it would go where it would do the most good—in the highly agricultural southern portion of the basin, the San Joaquin Valley.

The agricultural richness of the Central Valley is almost unbelievable. The valley grows 200 different crops.

The principal ones are cotton, alfalfa, irrigated pasture, sugar beets, beans, barley, and rice among the field crops; asparagus, tomatoes, melons, and a variety of other vegetables; fruits and nuts, including grapes, peaches, plums, apricots, pears, figs, walnuts, almonds, olives, and oranges.

Practically all of these crops are grown under irrigation except some barley, almonds, and beans. And a goodly portion of these crops are in the southern portion of the basin, or the San Joaquin Valley, which is served by the San Joaquin River.

Up to now, this area has leaned largely on its ground water supplies for irrigation. But these supplies are being exhausted and, if it weren't for the mass movement of waters from the Sacra-

THEY HAVE PROTECTION A-PLENTY—Both the tomato plants near Yettem in the San Joaquin Valley, with their weather caps, and the fields and livestock with their all-weather water-guaranteeing canals like this one.➤

mento River, almost 500 miles away, to this land of the good earth, the very livelihood of many farmers would be threatened. It might even have meant that the San Joaquin Valley would revert to desert.

But the Central Valley project has changed all that. It has assured the San Joaquin Valley of a new and supplemental irrigation source. It has already supplied the farmlands of the Tulare area with surplus water from the Millerton Lake storage reservoir behind Friant Dam in Fresno County. And, beginning this summer, the Tulare area will be assured of a firm, guaranteed supply of water from the Friant-Kern Canal. THE END.

SUMMARY OF INITIAL FEATURES OF CVP

SHASTA DAM—World's second highest and second largest concrete dam. Height, 602 feet; length of crest 3,500 feet. Amount of concrete, 6,500,000 cubic yards.

SHASTA LAKE—Storage capacity 4,493,000 acre-feet; shoreline, 365 miles; length 35 miles; surface area, 29,000 acres. Depth of water at dam, 515 feet.

SHASTA POWER PLANT—Capacity 379,000 kilowatts; number of generating units, five of 75,000 kilowatt capacity, two of 2,000 kilowatt. Average operating head, 375 feet.

SHASTA-TRACY EAST SIDE TRANSMISSION LINE—Length 231 miles; voltage, 230,000; type of towers, 100 miles of wood pole, H-frame remainder single circuit steel towers.

KESWICK DAM—Afterbay for Shasta. Height, 159 feet; crest length, 1,046 feet; amount of concrete in structure, 200,000 cubic yards. Capacity of reservoir, 24,000 acre-feet.

KESWICK POWER PLANT—Generating capacity 75,000 kilowatts. Number of units, three of 25,000 kilowatts each.

DELTA-CROSS CHANNEL—Control gates, two 30 by 60 feet radial gates, capacity, 7,600 second-feet. Length of excavated channel, one mile; natural channels used, 49 miles.

CONTRA COSTA CANAL—Length, 48 miles; capacity, 350 cubic feet per second; number of pumping plants, six; total lift 250 feet.

TRACY PUMPING PLANT—Number of pumps, six of 22,500 horsepower each; capacity, 4,600 second feet; total lift, 197 feet; number of discharge lines, three of 15-foot inside diameter; source of water, Sacramento-San Joaquin Delta, fed by Delta Cross Channel; source of power for pumps, Shasta and Keswick power plants via Shasta-Tracy 230,000 volt line.

DELTA-MENDOTA CANAL—Length, 117 miles from Tracy pumping plant to Mendota pool; capacity, 4,600 second feet; width at top, 100 feet, with 45-foot bottom; depth 18 feet; concrete lined with exception of short section at southern end.

FRIANT DAM—Fifth largest concrete dam in world, height, 319 feet; crest length, 3,488 feet; volume in cubic yards of concrete, 2,135,000. Reservoir capacity, 520,000 acre-feet.

MADERA CANAL—Length, 37 miles from Friant Dam to Ash Slough; capacity, 1,000 cubic feet per second.

FRIANT-KERN CANAL—Length, 153 miles from Friant to Bakersfield; capacity, 5,000 second feet.

FROM DESOLATION AND DROUGHT such as that depicted at left, Central Valley project canals like the Madera Canal shown below have, are now, and will continue to rescue productive and potentially productive farm lands in the once water-deficient San Joaquin Valley of California.

ONE HUNDRED YEARS OF IRRIGATION IN THE CENTRAL VALLEY, CALIFORNIA

by JAMES G. LINDLEY, Regional Operation and Maintenance Supervisor, Region 2, Sacramento, Calif.

From almost zero in 1850 to more than 4 million acres in 1950, producing approximately 200 different commercial crops—that is the record progress made in developing irrigation in the Central Valley of California.

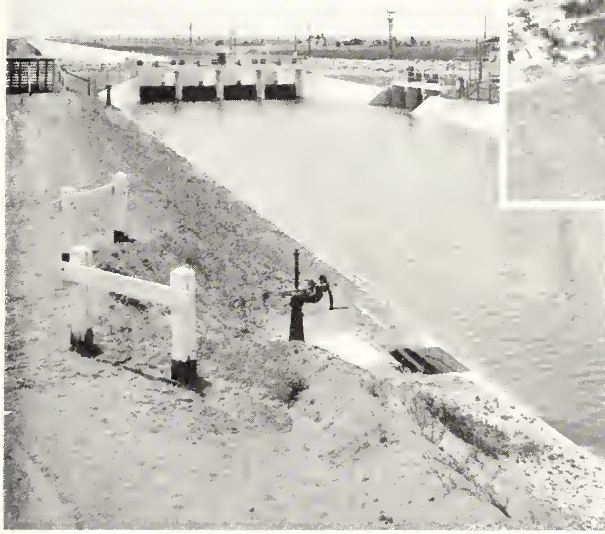
Although some water was diverted from local streams and some water from mining ditches was used prior to 1850, the first major canal constructed in the San Joaquin Valley was the Miller and Lux Canal in 1870 which reached from the great bend in the San Joaquin River northward to Newman. This canal later was extended to Crows Landing, and was used mainly for the production of forage on thousands of acres of easily accessible lands.

Soon afterward the Calloway Canal was constructed by the Kern County Land Co. This canal diverts water from the Kern River near Bakersfield and serves many thousands of acres between the Kern River and Poso Creek. Like the Miller and Lux Canal to the north these waters were used largely for production of forage to supply cattle feed.

The success of the above mentioned canals in supplying water for irrigation encouraged many other diversions. The potentialities of irrigation encouraged the planting of perennial crops such as alfalfa, trees, and vines. With the increase of permanent crops, firm supplies of irrigation water were imperative.

Probably the most important milestone in irrigated agriculture in California was the passage of the Wright Act in 1887. This act permitted

TO PROSPERITY AND PLENTY as exemplified by the Delta Cross Channel at right which diverts Sacramento River water into the Tracy Pumping Plant. This exchange of waters between two rivers helps fill the Friant-Kern Canal below.



irrigation districts to levy assessments and issue bonds to finance irrigation developments. Contemporary to and immediately following the passage of the Wright Act a number of irrigation districts such as the West Side, Modesto, Turlock, Alta, and Tulare Irrigation Districts in the San Joaquin Valley and Browns Valley Irrigation District in the Sacramento Valley were formed in the late 80's.

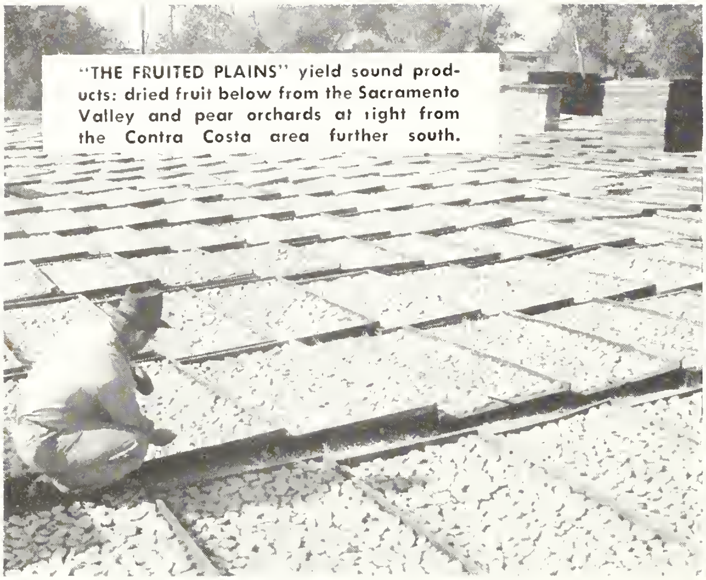
As irrigated crops increased, extensive development of agricultural handling and processing industries such as commercial dairying, fruit shipping, canning and drying, wine making, and vegetable handling and shipping industries soon followed.

In the period from 1900 to 1930 irrigation facilities were rapidly extended. In these 30 years more than 50 irrigation districts were formed. The tempo of the growth of irrigation was increased by the high prices of agricultural products occasioned by World War I. During this period such crops as cotton, sugar beets, rice, almonds, and prunes became major crops in the Central Valley area. The development first of the centrifugal pump and later the turbine pump and the improvement in fuels permitted the expansion of irrigation into areas where water could be less easily diverted. An extensive citrus industry in the thermal belt area of eastern Fresno and Tulare Counties, fruit and field crop production on the fans of Cache and Putah Creeks all became possible because of the development of suitable irrigation pumps during this period.

Low farm prices of the 1930's caused an abandonment of some irrigated acreage in the Central Valley but the requirements for agricultural products brought on by world unrest since 1940 has occasioned a major increase in irrigated acreage. Deep pumping in western Fresno County for production of cotton, flax, alfalfa, and truck crops and the expansion of irrigation in the winter truck gardens of the Arvin-Edison area are two of the more pronounced developments occurring during the last few years.

Far-sighted individuals foresaw that the water supplies in the San Joaquin Valley were inadequate to supply the needs for irrigation of all of the lands. The State engineer's office started studies of land and water resources in the State as early as 1868. By 1930 the State engineer reported on the State Water Plan which had been under investigation for many years. One of the major features of this plan was to export water from the Sacramento Valley, which had an excess of water, to the San Joaquin Valley where there was a great deficit. The plan, known as the Central Valley Project Act, was submitted to the State

(Please turn to page 183)



"THE FRUITED PLAINS" yield sound products: dried fruit below from the Sacramento Valley and pear orchards at right from the Contra Costa area further south.

Central Valley Project—A Sound Investment

by THOMAS K. VASEY

Regional Programs and Finance Officer
Sacramento, Calif., headquarters for Region 2

THIRTY-FOUR MILLION DOLLARS, representing 9 percent of the Federal money invested in the Central Valley project to date has been returned to the United States Treasury through water and power sales. This healthy achievement was made with the project in partial operation only.

Of greater benefit than the money returned to the Treasury is the project's contribution to the total wealth of the Nation in increased agricultural and industrial production made possible by the availability of additional water and power.

Funds advanced by the United States Treasury on approval of Congress for construction, operation and maintenance of irrigation works and power facilities must be repaid from project revenue. Costs allocated to flood control and navigation, considered to be of benefit to all the people, are borne by the Government and not repaid.

A repayment analysis made for the initial features of the Central Valley project (House Document 146, 80th Cong., 1st sess.) indicated the required repayment could be made by the end of fiscal year 2005, or 60 years after the first project operation in fiscal year 1945.

The estimated cost of the American River Development, recently authorized by Congress as a part of the Central Valley project, will be repaid within the original payment period. The additional revenue from water and power sales assumed from the operation of this new portion of the project will make possible this repayment. A new repayment schedule prepared as a result of the American River development being authorized as a part of the Central Valley project indicates the final payout date the same as in House Document 146 and, in addition, it is estimated there will be $87,000,000 in power revenues accumulated over and above the required repayment.

Power, irrigation's paying partner, has been the principal source of revenue for the Central Valley project to date. Some municipal and industrial, and irrigation water revenue has been realized from deliveries through the Contra Costa Canal, the Madera Canal, and a portion of the Friant-Kern Canal. Water revenue will increase in succeeding years as the distribution systems for irrigation districts are completed and the main canal system of the project is placed in full opera-

tion. The chart, "Central Valley Project, Summary of Operating Results" shows the high net returns realized from project operations.

Almost 90 percent of the total cost of the project will be repaid to the United States Treasury by revenues resulting from the sale of electrical power and water. Power revenues will eventually pay for approximately 45 percent of the project and revenues from the sale of irrigation, municipal and industrial water, will pay for approximately 42 percent. The remaining 13 percent of the project cost involves features incorporated in the project for flood control, navigation, fish and wildlife protection, salinity repulsions, and recreational use. These latter costs represent a contribution of the people of the United States to the national welfare.

Fifty-six percent of the total estimated construction costs of the authorized project have been spent to date. This virtually completes many of the initial backbone features and places the project in partial operation. The remaining 44 percent includes the cost of developments which have been recently authorized by Congress for inclusion in the over-all project such as the power development on the American River (estimated cost $32,000,000), and Sacramento River Canals (estimated cost $42,000,000). In addition to these two items there remains a third, approximately $70,000,000 of additional distribution system construction. This latter item results from requests by local irrigation districts that the Bureau construct their distribution systems. Contracts for repayment of this expenditure will be made by the districts prior to construction.

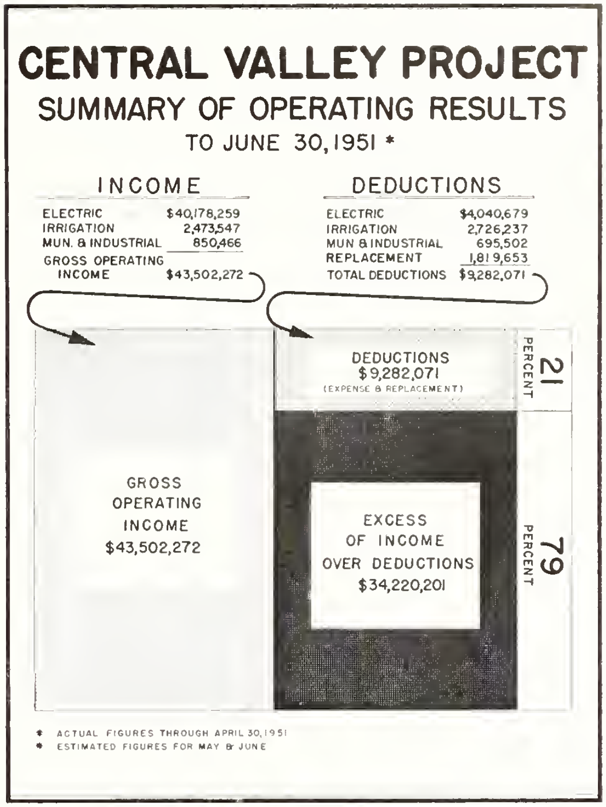
When all authorized features of the Central Valley projects are completed, it is estimated they will cost $625,300,000, of which approximately $350,000,000 has been expended.

Construction progress to date has brought many of the initial features of the project near completion. Fiscal Year 1951 construction costs approached $47,000,000.

The principal items of cost during fiscal year 1951 were $2,300,000 for dams and reservoirs; $1,900,000 for the Tracy pumping plant; $22,500,000 for the canal system; $11,700,000 for the power facilities; and $6,400,000 for the water distribution systems for irrigation districts. The balance ($2,200,000) includes the cost of water rights, utilities, housing and other related items.

THE END.

THE POINT OF HIGH RETURN has already been reached although the Central Valley project has only been in partial operation.



Kern County Officials Sign Recordable Contracts

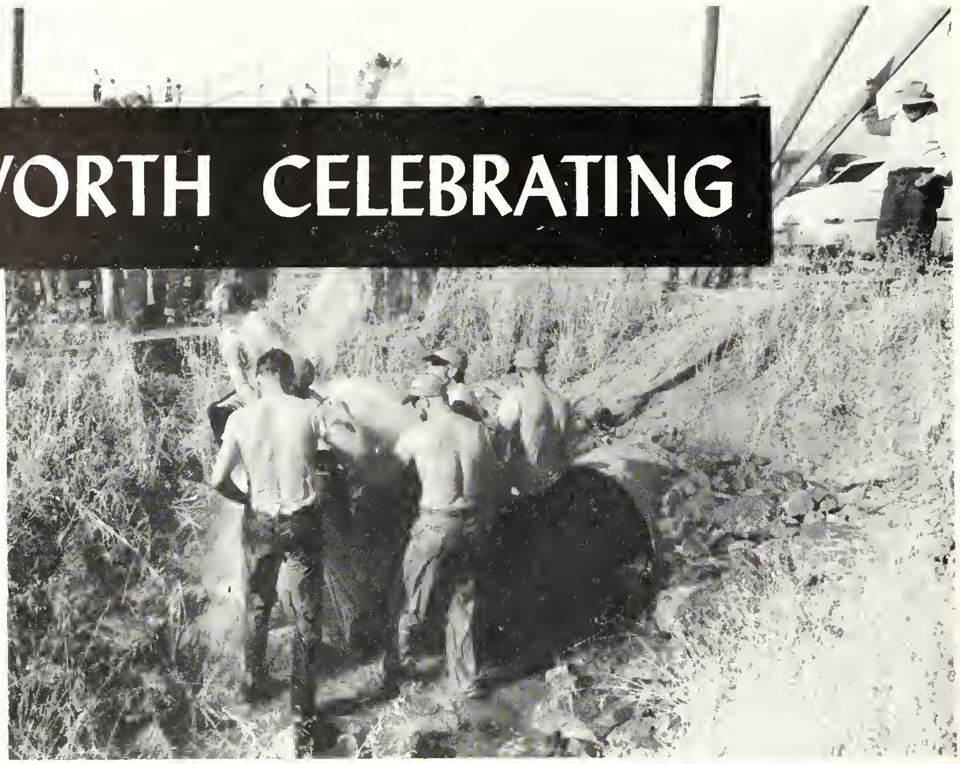
Officials of Lanza Vineyards, Inc., and Billings Ranches, Inc., both located in Kern County, have signed contracts with the Bureau of Reclamation under which they agreed to dispose of land in excess of 160 irrigable acres, at prices determined by an appraisal board. Signing the contracts for the corporations involved were W. W. Owen and R. L. Billings, presidents of the respective land companies.

R. S. Calland, acting regional director of the Bureau of Reclamation, in announcing the action, pointed out that under Reclamation law, an owner can receive Central Valley project water for only 160 acres of his holdings, unless such a recordable contract is signed.

Lanza Vineyards agreed to dispose of 1,120 excess acres in the Southern San Joaquin municipal utility district, and 820 acres in Delano-Earlimart. Billings Ranches, Inc., have agreed to dispose of 160 excess acres in the Delano-Earlimart district. The contract allows the companies 10 years to conclude the sales. ●

WELL WORTH CELEBRATING

by
WILLIAM M. CARAH
Sacramento, Calif.



THEN AS NOW—In 1949 the Orange Cove Lions threw a big shindig to celebrate receiving the first water from the Friant-Kern Canal.

FIFTEEN CALIFORNIA COMMUNITIES are pushing to completion their plans for participating in the Central Valley Water Festival from August 1 to 10, marked the first full, integrated operation of the great Central Valley project.

Residents of the State's fabulous interior valley agricultural empire will celebrate the arrival of life-giving water with ceremonies, regattas, parades, aerial exhibitions, barbecues, and pageantry during its 10-day journey from Shasta Dam on the Sacramento River, to Bakersfield, terminus of the Friant-Kern Canal, nearly 500 miles to the south.

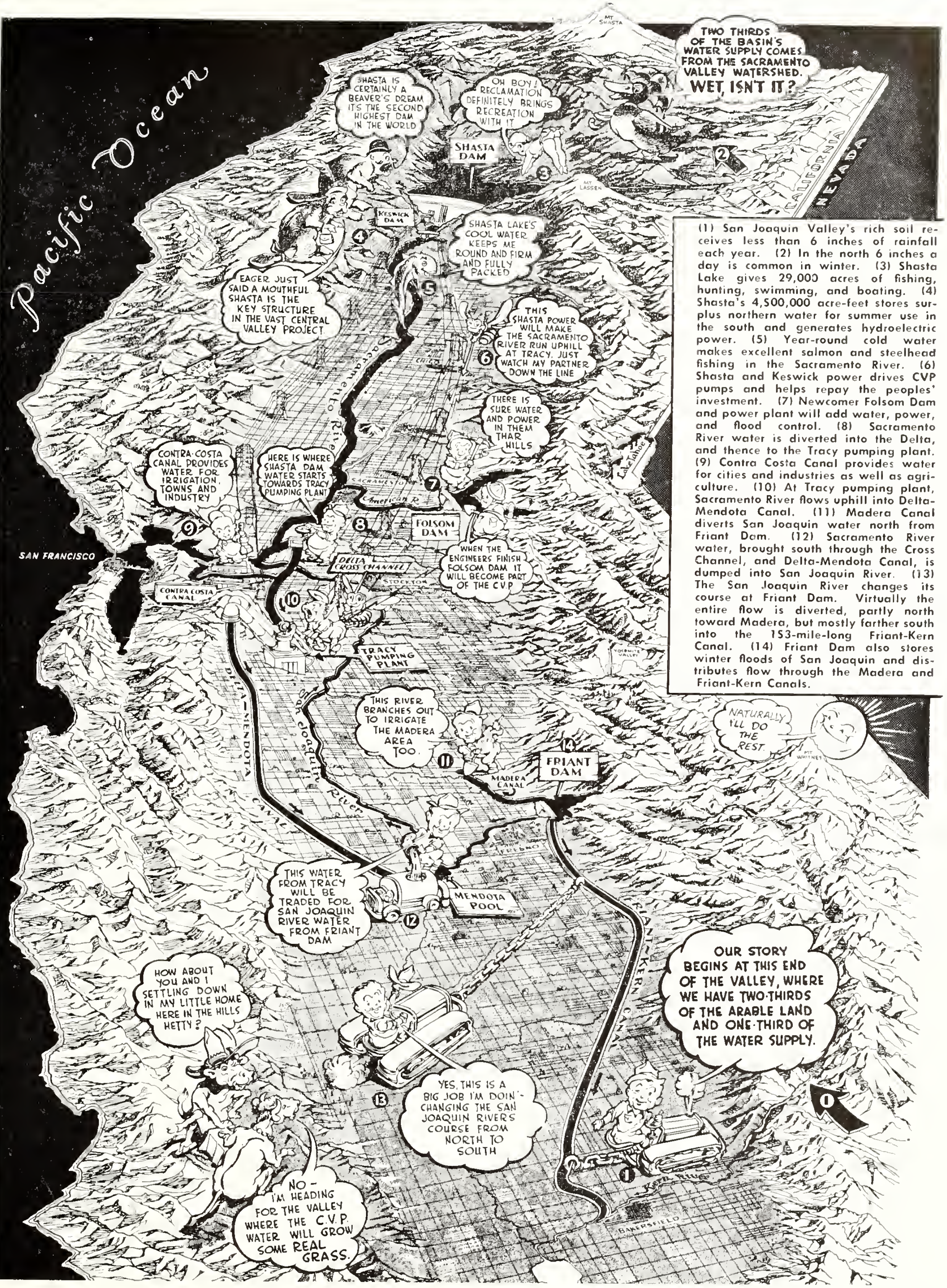
Just as CVP means many things to many communities, each one is planning an event highlighting a particular phase of the project as it affects a particular area.

But all of them revolve around the theme of water, which is more important to California today than was gold to the State a century ago. Agriculture is the State's major industry, and every member of the commonwealth is in some way affected by the rich production of its farm lands.

At Shasta Dam, the initial ceremonies on August 1, will dramatize the collection and storage of water from the streams of the water-surplus northern mountains, and the generation of a huge block of hydro-electricity energy at Shasta and Keswick power plants, to supply farms, homes, and industry of the State.

Ten miles downstream from Shasta lies the enterprising lumber and mining center of Redding, whose late leaders, John McColl and Francis Carr, worked tirelessly during the early days to make CVP a reality. On the evening of August 1, Redding will take cognizance of that part played in the project's development, and of its position at the head of the great Central Valley basin. Appropriately, the events will be held on the banks of the Sacramento River, which carries CVP water from Shasta to the southern end of the State. Highlighting this relationship, two of Redding's leading citizens will embark down the river by boat, carrying a cask of Shasta water to the dry farm lands of the south.

At Red Bluff, below the mouth of Iron Canyon, the river changes its character from a swift, turbulent mountain torrent to a placid, slow flowing stream. Here the terrain also makes a marked change. It is the real beginning of the great Central Valley, where a reliable water supply can mean the difference between life and death of agricultural growth. Then, on August 2, the people of Tehama, Glenn, Colusa, and Butte Counties, which form the upper tip of the valley, will



(1) San Joaquin Valley's rich soil receives less than 6 inches of rainfall each year. (2) In the north 6 inches a day is common in winter. (3) Shasta Lake gives 29,000 acres of fishing, hunting, swimming, and boating. (4) Shasta's 4,500,000 acre-feet stores surplus northern water for summer use in the south and generates hydroelectric power. (5) Year-round cold water makes excellent salmon and steelhead fishing in the Sacramento River. (6) Shasta and Keswick power drives CVP pumps and helps repay the peoples' investment. (7) Newcomer Folsom Dam and power plant will add water, power, and flood control. (8) Sacramento River water is diverted into the Delta, and thence to the Tracy pumping plant. (9) Contra Costa Canal provides water for cities and industries as well as agriculture. (10) At Tracy pumping plant, Sacramento River flows uphill into Delta-Mendota Canal. (11) Madera Canal diverts San Joaquin water north from Friant Dam. (12) Sacramento River water, brought south through the Cross Channel, and Delta-Mendota Canal, is dumped into San Joaquin River. (13) The San Joaquin River changes its course at Friant Dam. Virtually the entire flow is diverted, partly north toward Madera, but mostly farther south into the 153-mile-long Friant-Kern Canal. (14) Friant Dam also stores winter floods of San Joaquin and distributes flow through the Madera and Friant-Kern Canals.

be celebrating the passage in Congress of the latest addition to CVP—a series of irrigation canals, diverting from the Sacramento at Red Bluff, and serving 200,000 acres in their areas. (See article entitled, "Canals for Sacramento Valley," page 138, July 1951 issue).

Farther down the river, in the heart of the Sacramento Valley, another big river, on whose banks gold was discovered in 1848, now brings to the Central Valley basin riches in a different form. At the confluence of the American River and the Sacramento, lies the State Capital of Sacramento, also once dependent on gold, but now the center of a great agricultural area depending on water. This thriving city will be the scene of the events of August 3, marking arrival of CVP water and the addition of the Folsom Dam and power plant to the project.

Meanwhile, a series of related events will be leading up to the central ceremony of the Central Valley Water Festival at Tracy pumping plant. The city of Tracy, near which the 135,000 horsepower pumping plant will lift Sacramento River water into the Delta-Mendota Canal and thence into the San Joaquin Valley, will start its 3-day celebration. On the morning of August 4, the Port of Stockton will play host.

At 2 p. m. on August 4, a button will be pressed, sending power from Shasta and Keswick Dams into the six 22,500 horsepower motors of the Tracy pumping plant, lifting CVP water into the Delta-Mendota Canal, and placing CVP into full operation. From Tracy south, the project and the celebration enters a new phase—that of placing the water on the land.

Los Banos, located in the rich east side of the San Joaquin Valley, is in the center of the farm area through which the Delta-Mendota Canal passes, en route south, delivering some of its water along the way, but transporting the bulk of it to the Mendota pool on the San Joaquin River 120 miles distant from the pumping plant. Citizens of this area will mark arrival of CVP water with ceremonies on August 6.

At Friant, on the San Joaquin River northeast of Fresno, the great concrete Friant dam spans the river canyon. Here the waters of the stream are turned south into the great Friant-Kern Canal, from which they are turned on to the rich lands of the San Joaquin Valley, with its billion dollar crops and 3,500,000 cultivated acres.

Joining in the celebration to be held on the shores of Millerton Lake behind Friant will be communities, organizations and individuals from the rich area served by the Madera and upper Friant-Kern Canal.

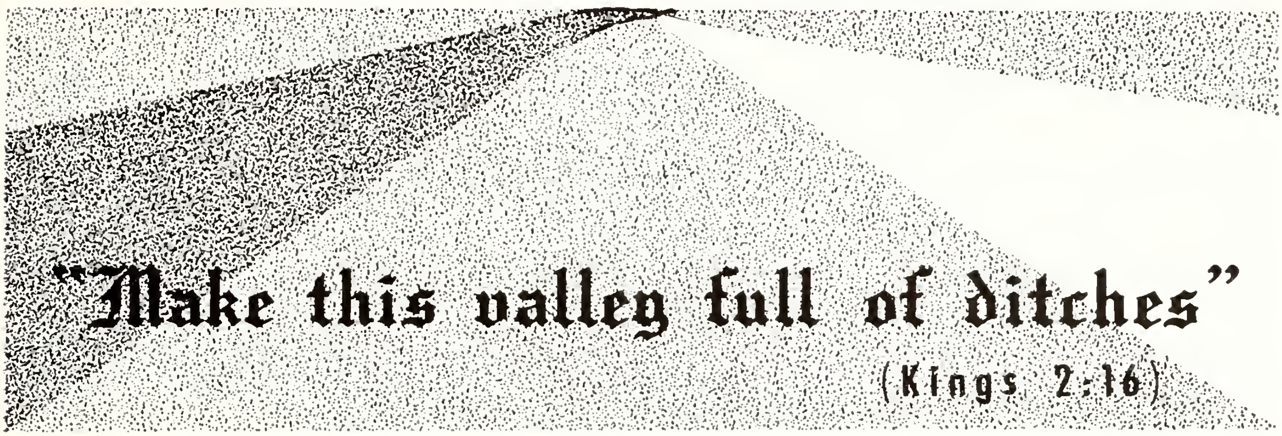
At Friant, CVP canals run both north and south. From the east abutment of the dam, the Madera Canal meanders north 37 miles to Ash Slough, which runs through the Madera and Chowchilla areas. From the west side of massive Friant, the Friant-Kern Canal runs south, 153 miles through some of the valley's richest land to the Kern River near Bakersfield. At Chowchilla, not far from the spot where the Madera Canal empties into Ash Slough, directors of the Chowchilla water district are planning an observance on August 8 highlighting benefits from Millerton Lake.

As it carries its load of life-giving water down the valley, the Friant-Kern passes through the rich and highly developed citrus and olive belt centering around Lindsay. Here, in the words of a veteran newspaper editor of Lindsay, CVP water arrived just in time to prevent the loss of thousands of acres of valuable orchards. Already arrival of the water has been felt by the area's economy. Thus, also on August 8, the communities of Lindsay and Orange Cove will mark the arrival of CVP water and celebrate its benefits, present and future.

Past Lindsay, the canal leaves the foothills and flows across the flat lands of the rich cotton and potato land of northern Kern County, and finally to the Kern River west of Bakersfield. Last outlet along the canal for CVP water is in the Southern San Joaquin municipal utility district, which has its headquarters near Delano. This community has planned an observance on August 9.

Bakersfield is the metropolis of the southern San Joaquin, deriving its growth and livelihood from oil and agriculture. It is a center for the great new cotton economy of California, and for a vast potato growing and processing area. Dozens of other crops from grapes to alfalfa also contribute to Kern County's agricultural prosperity, to which water is of the greatest importance. There, on August 10, will be the fitting climax to the Central Valley Water Festival. On the banks of the Kern River, where the canal terminates, will be the fourth and last major observance of the 10-day celebration as water from Shasta Dam, 500 miles to the north, is spilled into the utmost reach of the "push-button" waterway. THE END.

THE SAGA OF CENTRAL VALLEY



by MICHAEL W. STRAUS

Commissioner of the Bureau of Reclamation

LONG BEFORE THE BIRTH OF CHRIST, a wise man named Elisha, who lived in a land dry as the Central Valley, spoke these words:

> . . . Thus saith the Lord, make this valley full of ditches.
>
> . . . for ye shall not see wind, neither shall ye see rain; yet that valley shall be filled with water, that ye may drink; both ye, and your cattle, and your beasts.

Elisha, the prophet, knew that man could not long dwell in an arid land unless he irrigated the soil.

And today, in this age of scientific marvels, we have reached back to the dawn of civilization for the simple truth that has enabled California to become one of the most prosperous States in the world's richest Nation.

For a century of experience, some of it black and bitter, has taught that the irrigation ditch is the symbol of security and prosperity in this land of normal drought.

After the great cattle empires had arisen and fallen; when the wealth of the vast wheat fields had vanished in a cloud of dust from the exhausted earth; and the army of the gold miners had dwindled to a corporal's guard—California knew that in her arid Central Valley lasting prosperity could exist only amid green irrigated fields and orchards.

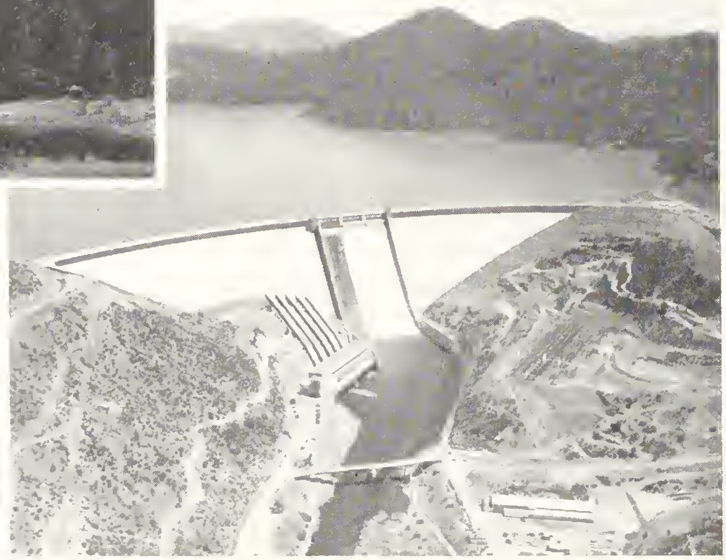
So, today, we mark triumph of the irrigation ditch over the desert.

California, at last, can make the Central Valley full of ditches. These ditches will keep the homes of her 10,000,000 people of today, and her 20,000,000 people of tomorrow, secure and filled with good living.

The first mass movement of irrigation water throughout the entire length of this Valley, the first surge of the water, marks the beginning of full-scale operation of your Central Valley reclamation project. And, through the operation of this project—as one single, complete and integrated system for regulating the rivers, conserving and transporting water to serve the entire valley, you can have enough water for your fields, for your rapidly growing urban communities, and your expanding industries.

And, you can have the hydroelectric power, the

FROM SNOW-CAPPED SHASTA melting snows on the mountain peaks are caught and held behind Shasta Dam below, the key unit of California's Central Valley project. At lower left, Keswick Dam, the afterbay for Shasta, helps reregulate the Sacramento River and produce hydro power. At the bottom of the page, at left, the Tracy pumping plant lifts Sacremento River water into the lower valley to the south to fill canals like the Delta Mendota at lower right.



protection from floods, and from encroachment of the sea, and the many other benefits of multiple-purpose Reclamation development.

As you progress and grow, and as this project is expanded to provide more water and power for that growth, you can literally make the valley full of ditches. For you shall have water to fill them!

To provide you with this water and the other benefits it has been necessary to build one of the world's greatest and most spectacular water resources projects.

By exchanging conserved and regulated flows of the Sacramento and San Joaquin Rivers, this project will move water virtually 500 miles, stretching from Shasta Dam, in the north, to below Bakersfield in the south. That is the longest movement of irrigation water man has ever attempted.

This day will open a new epoch in the prosperity of your State, one that will directly benefit your own lives, and bring a fuller measure of good living and security to the entire United States. The eyes of the whole world are upon you, as this project also demonstrates to hungry peoples all over this crowded earth, that better living and security can be found in well-planned, soundly conceived development of natural resources, under our democratic form of government.

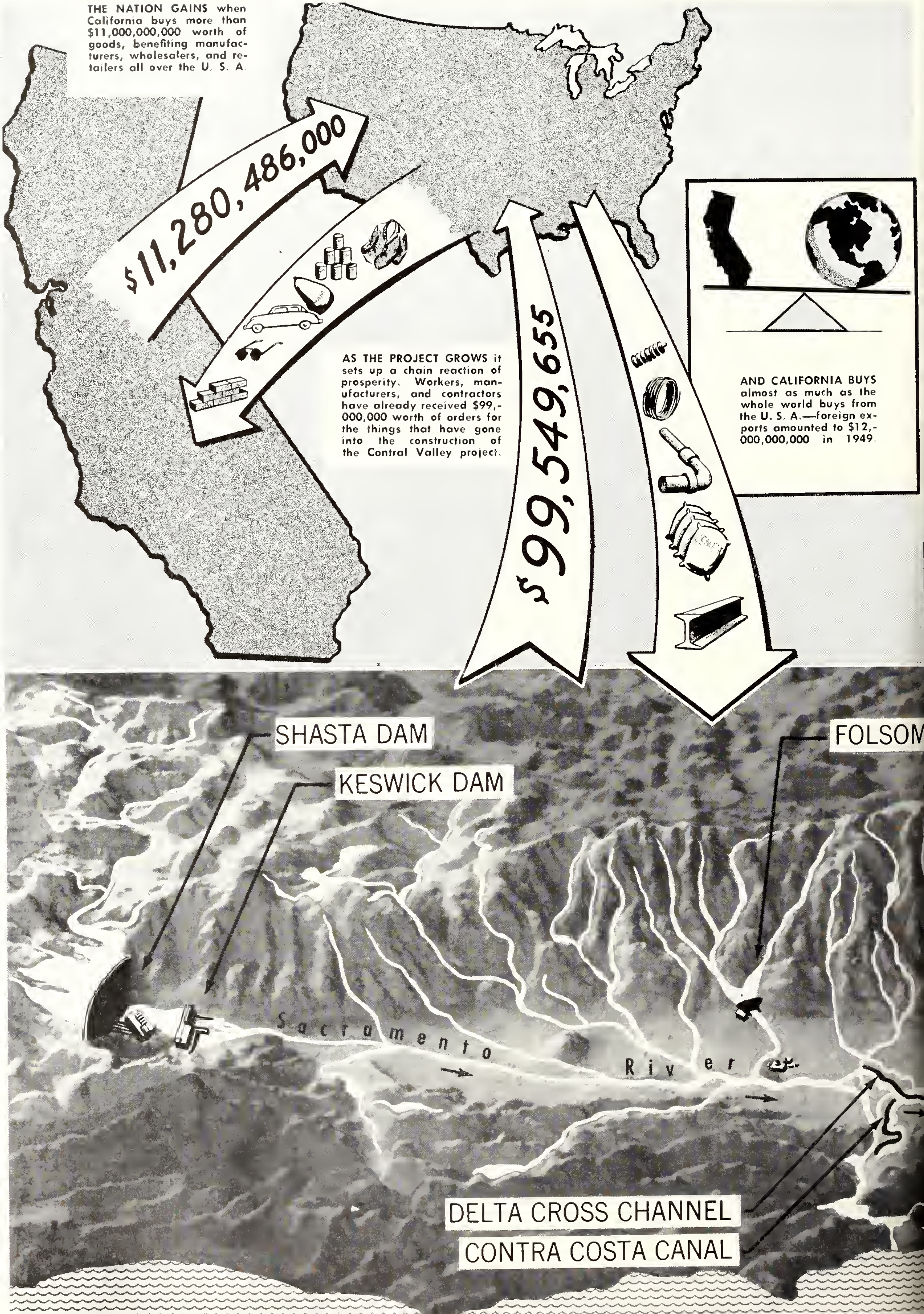
So, as the water progresses southward, throughout the vast project system that links rivers to river-sized canals, with Shasta's and Keswick's power plants, a network of transmission lines and Tracy's big pumps to boost it along the way, Californians will celebrate.

TO THE TIP OF THE SAN JOAQUIN water is transported through huge siphons (like the one above along the Delta Mendota Canal) and canals like the Friant Kern directly above, for multiple purposes, not the least of which is recreation. At left, an angler tries his luck in the clear cold water of Shasta Lake.

The celebrations emphasize, louder than words, how tightly the future of this entire valley, with its 1,500,000 people, living on its 60,000 farms or in its 83 cities and towns, is tied to this project. Your security and prosperity will be measured directly by the success of its operation. Your growth, and the future opportunities for your children and their children, will be molded by how well this project and its future units perform their functions for generations to come.

Some Californians were aware, as long ago as 1850, that the road to permanent prosperity lay over the irrigation ditches that would have to gird this valley. Some knew, as early as 1860, that major irrigation works, with great backbone canals, would be required. And that was long before anyone ever realized that the valley, a century later, would have become one of the Nation's most highly developed agricultural and industrial areas. Or that its farms would grow more crops than New England, its plants ship their wares all over the United States, and its people would buy merchandise ordered from all parts of the country.

The State's first legislature passed a law, in 1850, directing the surveyor general to develop a master water-resources plan, embracing irrigation, drainage and navigation, and encompassing both the Sacramento and San Joaquin Rivers. But the


THE NATION GAINS when California buys more than $11,000,000,000 worth of goods, benefiting manufacturers, wholesalers, and retailers all over the U. S. A.
$11,280,486,000
AS THE PROJECT GROWS it sets up a chain reaction of prosperity. Workers, manufacturers, and contractors have already received $99,000,000 worth of orders for the things that have gone into the construction of the Contral Valley project.
$99,549,655
AND CALIFORNIA BUYS almost as much as the whole world buys from the U. S. A.—foreign exports amounted to $12,000,000,000 in 1949.
SHASTA DAM
KESWICK DAM
FOLSOM
Sacramento River
DELTA CROSS CHANNEL
CONTRA COSTA CANAL

legislature didn't give him any money to do the job, and most people soon forgot all about it in the mad, fabulous rush to strip the stream beds and the hills of gold.

It has been a long, rugged road, from that day to this. Californians have fought the lack of ditches and the shortage of water year by year, every foot of the way. One of the marvels of our time is how the people of California have achieved this great and expanding economy despite an insecure water supply.

But the need for firm water supplies, and a valley full of ditches, haunted those brave pioneers all along the way. Voices crying for more water, and for longer, wider, deeper, fuller, and more numerous ditches, and for more farms and homes for a growing people were heard louder and louder with each passing generation.

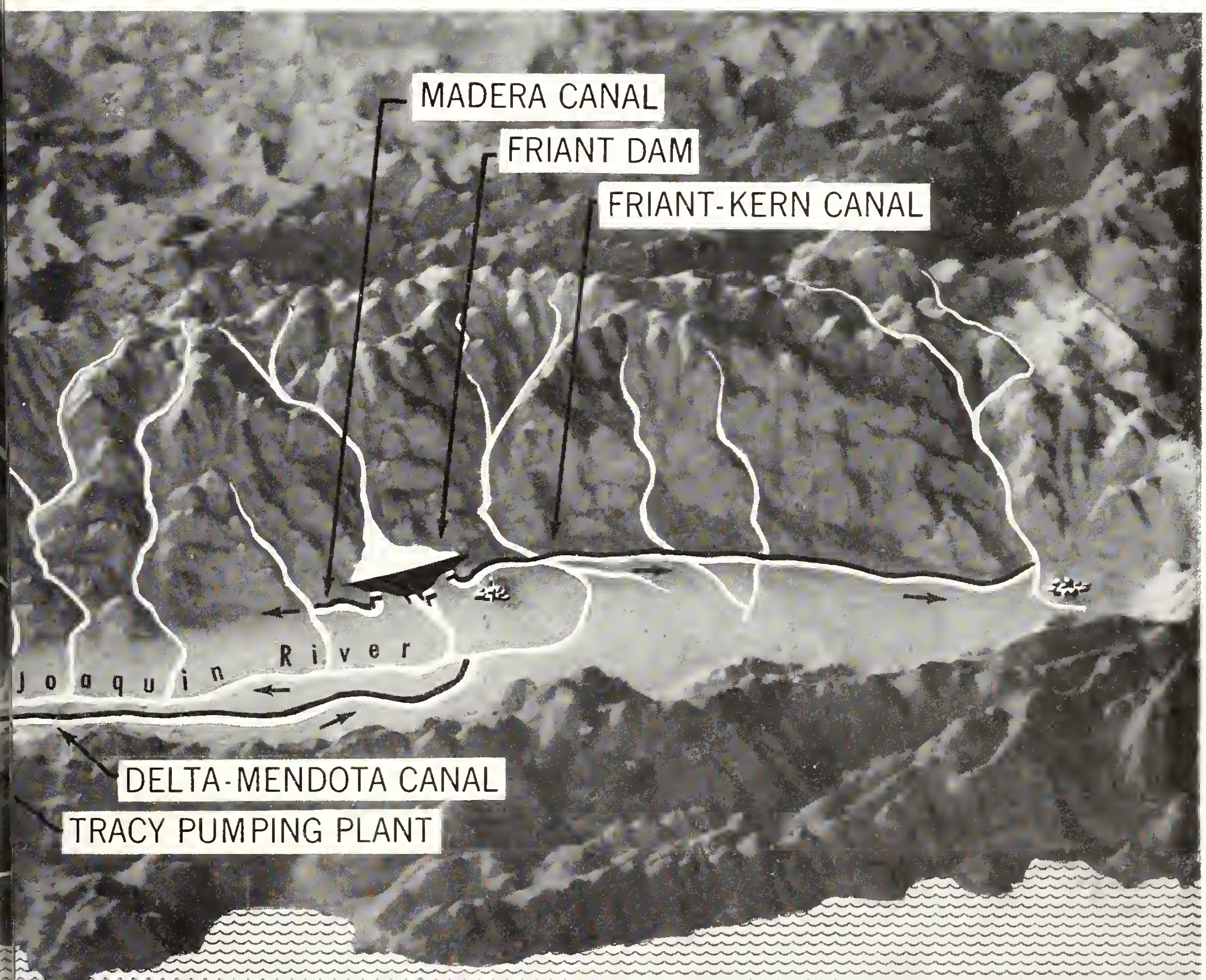
When the covered wagons wheeled their weary, dusty way into this valley, they found great seas of wheat, as the cattle empires of the grand seigneurs gave way to the realms of grain. There was no other wheat country like it. The endless fields

"THAT SEES BEYOND THE YEARS" this line from "America, the Beautiful" typifies the late Col. Robert Bradford Marshall, considered the real father of the CVP who first dreamed of harnessing the Central Valley streams and spreading their life-giving waters over the thirsty acres by a network of canals. He worked so devotedly at promoting his plan, called "The Marshall Plan," that he lost his voice, but he said, "Even though I knew it would cost me my voice, I'd do it again. I am only one man, but millions of people will benefit from this project."

spread, farther and farther over the valley—great empires built on golden grain.

The seemingly unending flow of fine hard wheat poured into markets round the globe—Great Britain, China, Mexico, South America, and even to Australia, where the farmers had deserted their wheat fields for the gold fields below the Equator.

So the Central Valley became the abode of the wheat kings—who were heedless to Elisha's com-



mand to make the valley full of ditches. And the land grew weary of one crop, year after year. The impoverished soil blew away or was covered and poisoned by the gold miners' "slickens." Sludge from the great barrages of water washing away at the foothills in quest of gold filled up the rivers and drove them further from their banks, and the time came when grain could no longer be grown in the Central Valley with profit.

But out of the exhausted grain fields and the muck-covered valley floor there arose, like the phoenix of ancient fable, new life from the green, irrigated fields that began to reach back from the banks of the streams.

Irrigation began feebly and grew haltingly. And it began to grow in the same monopolistic tradition as the epoch of wheat. Big landowners built their canals and fought bitter legal battles, between themselves and with placers, over rights to use of the water. Large water companies grew up as more capital poured into the new irrigation systems.

But in the Sacramento Valley there was one man among the wheat kings who knew that the march of time would soon catch up in California—that the day would come when men and women seeking their own small farms to raise their families could no longer be denied. Perhaps he knew that day would grow nearer as the ditches reached out from the rivers to make possible the small farms that now stretch out over the landscape.

The man was Joe Cone, who held a rich empire along the Sacramento. As early as 1890 he began subdividing his holdings. He even built a small power plant on Antelope Creek—to light his home and barn and to provide the first electric energy for other homes and families at Red Bluff.

Joe Cone, by his actions, was a prophet.

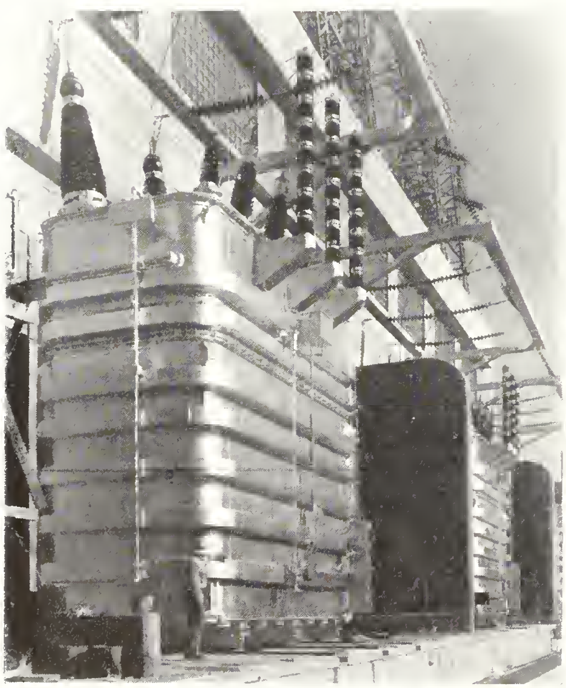
And there were some who harkened to the words of Elisha—and spoke with a voice steadily growing stronger—that the valley must be made full of ditches.

They were first heard in the Nation's capital in 1873. Congress authorized the study of irrigation development for the Central Valley and Col. B. S. Alexander of the War Department, a year later, submitted the first comprehensive plan for full use of the valley's water resources.

Where men had previously talked of great canals, running from South to North, tapping water sources of the San Joaquin River, Colonel Alexander found that the major source of the available water lay to the north—in the snow clad mountains flanking the Sacramento.

He laid down a plan, in strategy, if not in detail, similar to that of the Central Valley project whose waters are unleashed today.

But his was only the first feeble step. A few years later, the State Constitutional Convention ordered the planning of a State-wide water resources system. And that convention declared



FOR THE POWER to help pay for the project, to light the homes, farms, and cities, to turn the wheels of industry, to pump the water into the fields belongs to the people. Keswick power plant at left, is one which has already proved its worth. And with the power and the water, the people produce fabulous crops, like the bales of cotton shown below.

AND THE GLORY of richly yielding fields, flourishing farms, and prosperous people depends upon fairly distributed water. Sacramento Valley may some day be full of ditches and green from foothill to foothill—now the fields, like the one at right top, are narrow green strips along the river. And Fresno, where corn is being cultivated in the other photo, now has one of the biggest ditches of all—river-sized Friant Kern Canal, in which is mixed many waters—from nearby lakes and far-away streams.

against land monopoly and even talked about family-sized farms, foreshadowing the present-day Reclamation laws and the Federal Reclamation policy—which is in full accord with the State of California and sprang from a proclamation in the Homestead Act of a most distinguished Republican, Abraham Lincoln.

From these beginnings, there slowly emerged the outlines of what was to become today's Central Valley project. Col. Robert Bradford Marshall, Chief Geographer of the Geological Survey, worked tirelessly to bring the problem to public understanding—and worked out a plan for a great system of dams, canals and other works that envisioned today's development. His plan, made public in 1919, was placed before the California Legislature in 1921. (He was nominated to Reclamation's Hall of Fame in the January 1950 issue of the RECLAMATION ERA.)

California's own Ed Hyatt, another of the outstanding men of Western water resources development, worked tirelessly and effectively in further molding the water development, until the day, in 1931, when the "State water plan," the immediate forerunner of this project, received the approval of the legislature and the people of the State.

By that time, the growth of the Central Valley had far outstripped its safe developed water supply, particularly in the San Joaquin Valley. The valley had not been made full of ditches, nor had adequate supplies of water been made available. When the unconserved and unregulated natural flows of the streams had all been put to use, men dug and drilled into the earth to pump out water for their ever-spreading irrigated fields. And the water was pumped from the ground faster than nature could replenish it.

The valley soon learned, from sad experience, the simple truth that security and prosperity could be won only by building dams to conserve the waters of the rivers, and great canals, pumps, power plants, and transmission lines to transport the water where it was needed, all working together as one great central system.

Until that was done, the valley could grow no more, and the desert would reclaim much of its present growth.

Your State then came to Uncle Sam for help. And the Federal Government's answer was President Franklin D. Roosevelt's approval of the Central Valley project in 1935, and an allocation of funds to get started. Engineers began the job of preparing construction designs and blueprints—a major task in its own right. The first earth was turned in 1937.

In August 1940, the first water was available in the Contra Costa Canal. Power surged over the lines, from the first of Shasta's huge generators in 1944. Except for vitally needed power features, construction was all but suspended during World War II, but once the shooting stopped, the work again went forward. In the meantime, the public was already receiving large benefits from operation of the features that had been placed in service.

Power from Shasta helped the Nation speed victory during the war—and the great generators

there at Keswick have since helped California through a period of phenomenal growth.

Shasta and Friant have saved millions of dollars that would have been lost, otherwise, through the floods they have helped to reduce—though the valley is yet a long way off from complete flood protection.

Encroachment of salt water from San Francisco Bay has been stopped.

The Contra Costa and Madera Canals have brought relief from drought in the localities they serve.

You have the assured protection of the Reclamation laws in the widest distribution of irrigation water to the public.

The works now going into project-wide service for the first time will provide additional water for a half million acres of rich lands, heretofore inadequately supplied with water. They will provide water to bring another half million acres of dry lands under irrigation, to provide new family-farm opportunities for your growing population.

But this is just the beginning. Proposals for further expansion to meet future growth have been placed before the Congress with the sanction of President Truman. These proposed works would provide water for 1,200,000 acres more lands for new and supplemental irrigation, over and above the present project acreage. The power plants of these proposed works could provide an additional 113,000 kilowatts of generating capacity.

Looking even beyond these projected works, the people of California will have the basic network of water resources facilities which can be expanded to enable them to put the last drop of Central Valley water to work, when the day comes that they will need it.

So let us heed the words of the prophet Elisha—to go forth and make the valley full of ditches with the firm assurance that the water will be ready to supply the needs of the people.

For there are rocks to be smitten for other waters to gush forth, even as Moses did for the children of Israel—when the streams of the Central Valley are working full-time and the day comes when more water must be found—that the valley may flourish and its people may prosper.

THE END.

"YET THAT VALLEY SHALL BE FILLED WITH WATER" and two valleys shall be as one, each with its ditches flowing full, its fields rich and green, its cattle and beasts of the field well fed, and its people blessed with the good things of the earth. And the San Joaquin Valley, shown below, with its rich groves of oranges and grapes, is only a sample of what the future will bring.

RECREATION in the Central Valley Project

by E. A. PESONEN, Administrative Officer,
Region 2, Sacramento, Calif.

WHERE NO LAKE EXISTED before the advent of the Central Valley project, yachts rock at anchor as the sun sets over Millerton Lake, a man-made haven of rest created by Friant Dam in California.

OVER A MILLION PEOPLE visited Shasta and Friant Dams under construction until gasoline rationing intervened in November 1942. They were mostly sightseers out to enjoy America and to see its wonders, natural and man-made. Most of them simply tried to comprehend the immensity of the undertaking and to sense the long-range economic values of the project. But there were others who visioned also something more direct, more imminent and more personal—recreation on the reservoir! Hundreds of people asked about cabin sites, resort locations, boating faciilties, and fishing opportunities on both Shasta and Millerton (Friant) Reservoirs.

Captains and corporals wrote from the far corners of the earth hoping to establish a small resort business or build a restful cabin away from the cares of the world. A few tempered their enthusiasm with caution. They saw a reservoir, rather than a lake, a reservoir of diminishing proportions as the summer progressed, especially in dry years. They asked, "What will the drawdown be?" and "When will it occur?"

Under the leadership of the National Park Service, a committee of representatives from 20 Federal, State, and county agencies prepared a report on the recreational potentialities. Those who would like to obtain more information on the subject might write to the Superintendent of Documents, Government Printing Office, for a copy of this report, entitled, "Problem 23, Central Valley Project Studies, Recreational Administration, May 1944."

Millerton Lake, lying in sparsely wooded foothills 20 miles northeast of Fresno, subject to a relentless summer sun and a drawdown of as much as 60 feet by the end of August, promised less ideal conditions for recreation. But with easy accessibility and a setting of verdant hillsides, the realization has exceeded the promise. As Millerton became the only sizeable lake within an hour's drive of more than 200,000 people, boats appeared by the hundreds as soon as the lake was opened to the public. Docks, a yacht harbor, picnic areas and sanitary facilities have been built. Community organizations have joined in planting hun-

dreds of trees. Thousands who man the farms and shops of the busy valley have found a restful place for Sunday picnics, an evening swim, a few hours' fishing, a quiet day's sailing, or a spin in a motor boat.

Using electric eye counters at the gates, the National Park Service, which manages the Millerton Lake area, reports the following use—415,000 visitor-days in 1949 and 475,000 in 1950—figures greater than those for many National parks.

Shasta Lake, reaching 35 miles back into the rugged canyons of the Pit, McCloud, and Sacramento Rivers and Squaw Creek, lies like a four-fingered claw on the map. Only by boat can you reach most of its 365 miles of shoreline. Its huge volume (4,500,000 acre-feet) makes it a more stable body of water than Millerton, the drawdown being influenced not only by annual demands but by carryover storage from wet to dry years. Like Millerton, it is most attractive in the spring. Then the lake is full and the red bud, buckeye, wild lilac, and western azalea glorify the mountainsides. Toward evening when the sun first hides behind the higher hills and the wind dies down, deer come out to graze near the water—except during the hunting season. Sometimes a black bear is heard crashing through the brush. Cormorants roost impassively in dead trees, wood ducks flap away as a boat approaches, occasionally a fish hawk swoops on an unsuspecting bass. Shasta is a wilderness lake.

Camping in bays accessible only by water, trolling for the elusive kamloops trout, casting for black bass, enjoying the peace of a cabin on some wooded north slope, or just taking a long boat ride to view the water and the rugged landscape—these are the recreational attractions of Shasta Lake.

Although the dams and reservoirs are the principal recreational attractions created by the Central Valley project, mention should also be made of the rivers. The San Joaquin, with nearly all the flow impounded by Friant Dam, will be replenished by Sacramento river water delivered to it at the Mendota pool via the Delta-Mendota canal. The Sacramento has already been improved. The large flows released from Shasta Dam in summer and the decreased flood hazard in winter have encouraged boating while the sustained releases coupled with lower water temperatures have made the river a trout and salmon stream for a hundred miles.

Integrated operation of the Central Valley project has just begun but recreation is already an important function of this vast multiple-purpose project. The vision of the citizens who saw it under construction and the findings of the committee which verified that vision have been fulfilled. THE END.

1

SPORTSMEN DELIGHT in such recreational pursuits as (1) catching bass from Millerton Lake, (2) spending a Sunday boating at Millerton, or (3) looking forward to the day when kamloops may be caught at Shasta. Here 25,450 of these fast-growing trout are being planted to provide the ultimate in "sporty" fishing.

2

3

KING COTTON and THE DROUGHT

by LLOYD B. SHINN, San Joaquin Valley District
Fresno, Calif., Region 2
Headquarters at Sacramento, Calif.

HOW DRY THE SOIL—Jack Locke sifts San Joaquin Valley soil through his fingers. It almost fades away in the wind.

THERE IS EVERY INDICATION that California's San Joaquin Valley will produce the biggest crop of cotton in its history in 1951. Plantings are estimated to be 1,200,000 acres for the entire State with San Joaquin Valley plantings representing 1,157,000 acres, more than 96 percent of the State's production. Other plantings are principally in the Imperial Valley.

The California average yield for the past 10 years has been 600 pounds per acre. Assuming this yield for 1951, the production of cotton in California will be approximately 1,500,000 bales, moving California up to third and possibly second position in national production of cotton. The 5 year 1946–50 average yield is 668 pounds per acre, however.

The 1950 yield was a phenomenal world record high of 823 pounds per acre which came about through a series of circumstances, the most prominent of which was the national and State curtailment of cotton acreage, causing growers to plant only their best lands to this best cash crop. Probably the next greatest influence in producing this highest yield was the very favorable growing season. Another prominent factor in producing the excellent yield was the statewide use of the new excellent cotton variety, Acala 4–42. This new variety has proved to be a high yielding, high-tensile-strength cotton in great demand by the mills.

In 1951 with no curtailment of acreage by a national cotton allotment program, and a price guarantee of about 30 cents per pound (90 percent of parity), the planting of cotton in the San Joaquin Valley of California has been limited only by the availability of irrigation water.

To take care of the expected increase in cotton production in the Valley, an additional 40 gins are being built to augment the 150 which are already on hand. During the last 3 years, a good share of the cotton has been picked by mechanical cotton pickers which numbered 1,200 in 1950. It is estimated that the increase in mechanical cotton pickers in 1951 will be limited to 600 because of the emergency program. The supply of labor appears adequate and most farmers are well equipped with tractors and cultivation and harvesting equipment to handle their farming operations.

In the face of all of these conditions favoring cotton farmers and other California farmers in the San Joaquin Valley is the menacing shadow cast by the seventh successive year of water shortage. Irrigation pumps and wells are being taxed to their utmost to supply water from increasingly greater depths. In numerous cases wells have been drilled to the lowest possible depths with only a temporary betterment of water supplies.

In 1948 in an east side area of ground-water measurement south of the Kings River service area (including parts of Fresno, Tulare, Kings, and Kern Counties) and continuing south to within 15 miles of the Ventura County line there had been pumped from the ground-water storage more than 1,100,000 acre-feet in excess of the natural inflow. This means that during 1948 this amount of water was used for agriculture in the area in excess of inflow to underground storage.

Much new land has come under irrigation since 1948, so that the overdraft on ground-water supplies in the area approaches 1,500,000 acre-feet in 1951. Beginning in 1945, inflow to ground-water reservoirs has been below normal because of insufficient runoff from watersheds in the Sierra Nevada Mountains to the east. Normal runoff is based upon a 45-year (long term) average.

The last year of normal or above normal runoff was 1944–45 when it was 32 percent above long-term or normal figures for the area. Since then runoff has been as follows: 1945–46, 86 percent of normal; 1946–47, 72 percent of normal; 1947–48, 50 percent of normal; 1948–49 50 percent of normal; 1949–50, 68 percent of normal; and 1950–51, approximately 55 percent of normal.

The cumulative effect of these years of below normal runoff or inflow to ground-water reservoirs, in conjunction with the greatly increased drain on pump-water reserves because of expanded acreage of cotton and other crops, has created a serious ground-water deficiency.

To alleviate this water shortage, deliveries of water from the Friant-Kern Canal began in 1949, and since that time have increased generally in line with completion of distribution systems for individual water user districts.

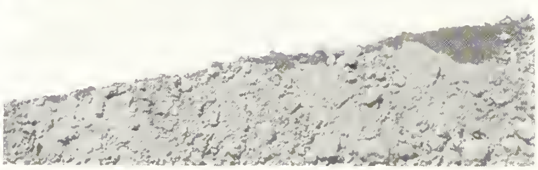
In addition to deliveries along the Friant-Kern Canal, water has been delivered in substantial amounts to the Madera irrigation district and Chowchilla water district from the Madera Canal and also to temporary water service contractors along the San Joaquin River.

Total diversions of water from Friant Dam to long and short-term contractors in 1950 amounted to 450,000 acre-feet and will total approximately the same in 1951. Availability of water from Friant Dam has been the direct cause of new acreage being brought under irrigation in the Friant-Kern and Madera Canal service areas and has been a source of supplemental water of considerably more acreage in these areas. This new acreage, brought into production since the start of the 1949 irrigation season, has amounted to 32,000 acres. Lands given supplemental water will probably amount to 466,000 acres in 1951.

Value of crops raised on the new acreage in 1949 amounted to $1,849,000; in 1950, $3,259,000; and in 1951, it is estimated that the value will total $7,500,000.

Gross crop income from acreage given supplemental water in 1949 amounted to $45,468,000; in 1950, it amounted to $98,328,000; and in 1951, it should amount to $110,000,000.

The importance of cotton in these areas receiving supplemental water from Friant Dam is shown by the fact that more than 126,000 acres were grown in 1950 with a gross farm value of $39,000,000. This represents over 20 percent of the entire California cotton acreage grown in 1950. THE END.



HOW WELCOME THE WATER—At left, Locke cleans mud from pipe outlet leading to irrigated cotton row. "Milky" water is due to chemicals, added to help penetration of "hardpan" strata. At lower left, cultivating cotton on land owned by A. Perelli-Minetti & Sons about 2 miles north of the town of McFarland. Below, seeding cotton on the Hartman Corp. land about 4 miles southeast of Delano. This land borders on the great Friant-Kern Canal.

"FOR PATRIOT'S DREAM"—The family-sized farms in the San Joaquin Valley near Fresno typify the long-awaited dream-come-true made possible by the Central Valley project whose features are being explained at left by the author to a group of visiting dignitaries.

The Central Valley Project—

TAKING INVENTORY

by RICHARD L. BOKE,

Regional Director, Region 2, Headquarters at Sacramento, California

ALTHOUGH COMPLETION AND FIRST FULL OPERATION of the Central Valley project's initial features represents an engineering feat of the greatest magnitude, and a major milestone in the history of water development, this event is but a way point in the Nation's efforts to bring to its people the largest possible beneficial use of its natural resources.

Much of the history of CVP has been the story of a struggle between the forces which set forth to implement this policy of fullest benefit to the greatest number of people, and those who would take these benefits for themselves, or thwart the public aims of the project.

The record is not only one of obstacles and delays, it is also one of great progress made in spite of these obstacles.

Huge amounts of irrigation water are being stored behind Shasta Dam, and are being delivered through river channels and man-made canals to the farm lands of the dry, but phenomenally rich San Joaquin Valley.

Public power is being generated at both Shasta and Keswick power plants, and is being transmitted over publicly owned and operated lines.

The CVP has been recognized by the Congress as a growing development, not a static project, by the successive addition of the American River division and the Sacramento Valley canals as authorized features.

Water contracts have been executed with 15 California irrigation or public utility districts, and negotiations are underway to bring CVP water to many others. All of these contracts are under terms of Reclamation Law, embracing the acreage limitation on project water delivery. Recordable contracts calling for disposition of excess lands have been signed, and more are on the way.

These contracts represent significant victories in the continuing fight not only to bring water to

the land, but to distribute its benefits as widely as possible consistent with the letter and spirit of Reclamation Law.

Although the acreage limitation has become a less embattled issue with the execution of these contracts, those who would have the project operated outside the Reclamation Law have been unremitting in their attacks. Presently the arena of battle is in the superior courts of the project service area's counties. In each case, before the contracts between an irrigation district and the Bureau of Reclamation become effective, court validation is necessary.

Another perennial maneuver concerns the operation of the project. An interesting observation in connection with these attempts is that proposals to have the State of California take over and operate the project are being pushed by much the same group which killed an earlier attempt to place CVP in the hands of the State for operation and maintenance. Thus it appears reasonably certain that the State vs. Federal control is not the real issue.

The doctrine of State or local operation neglects some elementary but important financial and political facts. All Federal reclamation projects, including the Central Valley project, have been developed by a direct Federal investment of funds appropriated by the Congress. The Government assumes the total cost of flood control, navigation, fish and wildlife preservation and conservation, recreation and other contributing benefits. Since the Central Valley project serves these major purposes, plus irrigation and power, the cost of water to the user is substantially reduced. Only power and irrigation costs are repaid to the Federal Government. Furthermore, Federal funds advanced for irrigation bear no interest.

Financial support for irrigation on this project, as on other great multiple purpose works, is available through the sale of project power, which makes it possible to deliver cheap irrigation water. Thus the thousands of irrigation farmers and the millions of electric power users have a huge stake in seeing that the project is operated in such a manner that these power benefits are equitably distributed.

The peoples' fight to attain these objectives has been marked by much the same maneuvering and tactics on the part of those who would control this great natural resource for themselves. Although this phase is continuing, much progress has been made. Early in June, power from Shasta and Keswick power plants was carried to the Tracy switchyard over Government owned and operated lines. Another public agency has contracted with the United States for CVP power, to be served in the near future under the recently signed wheeling agreement with the Pacific Gas & Electric Co. Negotiations will be pushed with other preference agencies to effect as wide a distribution as possible of the benefits of public power. Folsom power plant, which will have 162,000 kilowatts capacity, and Nimbus, which will have 5,000 kilowatts, are under construction by Reclamation as part of the American River development, a new addition to CVP. Studies are underway on the Trinity River, with its potential of 240,000 kilowatts capacity. Central Valley basin's power potential of more than 8,000,000,000 kilowatt-hours annually, has just begun to be tapped.

More encouraging, from the standpoint of accomplishment, is the number of water contracts, and the manner of their approval by the landowners of the various irrigation districts which will receive project water along the various great canals and waterways of CVP. Already contracts have been executed with 15 irrigation districts which are being served, or will be served from the

(Please turn to page 183)

"TO INSURE THE BLESSINGS OF LIBERTY" and freedom from the drudgery of backbreaking household chores is among them, made possible through the production of hydroeelctric power from the peoples' rivers, sent to the peoples' homes. ***Photogroph provided through the courtesy of the Rurol Electrificotion Administration.***

IT WASN'T EASY

by the staff of the Lindsay Gazette

EDITOR'S NOTE: The orange and olive growing community of Lindsay, in the heart of the San Joaquin Valley, has been for many years a leader in the development of water resources of the Central Valley basin. An example of this community's interest in the Central Valley project was the vote on the Central Valley project special election in December 1933 when the people of that community approved the legislation by a ballot of 2,202–4. Ford A. Chatters, co-publisher of the Lindsay Gazette, has given permission for use by the RECLAMATION ERA of this article telling the story of the long fight to obtain water for the orange and olive groves of the Lindsay-Strathmore area.

THE ARRIVAL OF CENTRAL VALLEY PROJECT WATER in the Lindsay district climaxed a 35-year struggle to secure water from an outside source.

Numerous local citizens were active in the move to bring outside water into this district, and into the South San Joaquin Valley, at a time when others here in the county, who later became aggressive "water plan proponents" actually were fighting these efforts. There were those who believed the coming of Central Valley water would aid and abet the Lindsay-Strathmore district in its bitter legal struggle with the Tulare irrigation district, and some 40 ditch companies in the Kaweah River watershed. Now all are friends.

Earliest productive effort came at the legislative session of 1921 when Tulare County's assemblyman, Charles W. Cleary of Lindsay, then serving as chairman of the assembly committee on irrigation, drafted a bill calling for the appropriation of funds for the study of a comprehensive Statewide water plan, looking to the maximum use of all the waters of this semiarid State. He gave the bill to Assemblyman Bradford S. Crittenden, Stockton, retired State senator, for introduction. Together they saw it successfully pass both houses. It was signed, and intensive study by the State engineering department followed.

In the meantime the "Marshall Plan" was being advocated. It proposed a system of gravity canals skirting the foothills, bringing the excess flood waters of the Sacramento, American, and other streams, southward into the South San Joaquin Valley.

By the time the legislative session of 1929 rolled around, the studies had evolved into a concrete plan, essentially the same as now is being realized. A salt water barrier in the lower Sacramento, in the Carquinez straits, to furnish water to the industries suffering from salt-water invasion, was injected into the plan. Engineers saw this as impractical, and it stirred a legislative fight which blocked any legislation at that session. Later the fresh-water Contra Costa Canal was substituted.

Earl Houghton of Lindsay and Strathmore, who

BUT IT WAS WORTH IT—As can be easily seen in the photo below showing the contrast between irrigated orange groves and dry farms not yet watered along the Friant-Kern Canal near Lindsay. At right, George Trauger points with his cane at the Lindsay-Strathmore irrigation district's pumps which lift water from the Friant-Kern Canal into the laterals.

just before, for 2 years, had been president of the California Farm Bureau Federation, headed an active legislative effort to secure the passage of the 1929 measure. Houghton and Ford A. Chatters, Lindsay, who handled a State-wide campaign through the press, remained in Sacramento throughout the 1929 session. For the first time the Central Valley plan was given legislative momentum and projected into the State picture.

Others at home helped, of course. John H. Turner, Lindsay, then was chairman of the Tulare County Water Commission. J. T. Crowe, Tulare, headed a committee supporting the legislative effort.

In the meantime, in 1928, a constitutional amendment was put on the ballot to modify the old English Common Law doctrine, then being applied to water law in California. The doctrine of "reasonable and beneficial use" was substituted. It had material relation to the over-all water picture, and in the exchanges of water necessary to realize the Central Valley plan.

The campaign for the act, before the November 1928 election when it was approved by a substantial margin, was headed up largely in this district. A Lindsay man wrote all the general publicity and, with Earle Clemens of Terra Bella, spent a month visiting every newspaper in the State. Lindsay-Strathmore irrigation district officials all were extremely active in this particular effort.

The late E. L. Daniells was president of the district at that time. Secretary H. R. Huebert and Engineer George W. Trauger, and some 5,000 or 6,000 residents of this district, took an active and intense interest. All can not be named here. Topside, Attorney General U. S. Webb showed a keen and friendly interest.

Then came 1933. Legislation again creating the Central Valley water project was introduced, in both the Senate and Assembly. Heading the list of co-authors in the lower house was Assemblyman Ford A. Chatters of Lindsay. Senator Frank W. Mixter, Exeter, headed a similar bill in the Senate. The Assembly bill, after a session-long struggle, emerged successfully and was signed by Governor Rolph. This measure called for a revenue bond issue of $170,000,000 for the construction of a water project substantially similar to that now being completed by the Bureau of Reclamation. It established also, the California Water Authority, which still exists under the terms of the act.

Held up by referendum, the act was approved by the people at a special election held in December 1933. Lindsay cast the astonishing vote of 2,202 for the act, to only 4 against. Strathmore voted in similar proportion. A. C. Tienken headed a fund-raising campaign. Altogether some $20,000 of Lindsay-Strathmore money was spent. Harold G. Schutt was chamber president at that time.

By this time, due to illness, W. B. Kiggens of Lindsay had replaced John Turner on the Tulare County Water Commission. He, together with Mr. and Mrs. George W. Trauger of Lindsay, were actively advocating the passage of the bill at the 1933 session.

Secretary R. I. Clearman and the Lindsay Chamber of Commerce contributed a vast amount of effort and money. Through all the years of water struggle the Lindsay and Strathmore Chambers of Commerce were extremely active.

The Lindsay Gazette and Publishers, A. L. Evans, and Ford A. Chatters, for three decades, did everything a newspaper could do toward the realization of a dream which had to become a reality if the district was to survive.

Charles F. Burr, then mayor, and city councils one after another likewise repeatedly took such official action as would aid in water development efforts. Successive heads of the Lindsay Farm Bureau and local service organizations, including the churches, aided.

We are well aware that hundreds of citizens of the Lindsay-Strathmore area played outstanding parts in the fight for water and a realization of the Central Valley project. For that reason this is confined largely to those local persons who held official status.

Many helped throughout the county. Committeemen active over the 30 years could be mentioned, and some day will be recorded in the annals of the long struggle for an adequate and sure water supply for the district.

To conclude. Soon after the Central Valley Act was passed in the California Legislature, and had been affirmed by the people, Federal, civil, and public works agencies, and the Bureau of Reclamation began seeking projects that would qualify for assistance and provide employment.

The California Water Authority turned the undertaking over to the Bureau of Reclamation after extensive investigation by Engineer Walker R. Young, who later was placed in charge of the building of Hoover Dam. THE END.

TAKING INVENTORY

(Continued from page 180)

Friant-Kern and Madera Canals. A dozen more have filed requests for service from the Central Valley project in the same area, and seven more districts have indicated interest in receiving water from the Delta-Mendota Canal when that unit of the CVP goes into operation in August.

As of this writing, the entire water supply available from Millerton Lake, in an average year, has been committed to water users in the San Joaquin Valley. Not only have CVP water contracts been approved by the people of the various irrigation districts, but they have been approved by overwhelming margins. For example, in the Lindmore irrigation district, the vote was in a 14–1 ratio for the contract. Lindsay-Strathmore voters approved CVP water contract by a vote of 188–1. In Exeter, the ratio was 10–1. And in two districts, Stone Corral and Saucelito, not a single negative vote was cast. The overwhelming majority is significant. It is unmistakable evidence that these 9 (d) and 9 (e) contracts, written under Reclamation Law, and containing the acreage limitation features, are in accord with the will and the needs of the vast majority of the valley's water users.

In these districts, a $70,000,000 distribution system program is under way, the cost of which is advanced to the water users by the United States, without interest. This program is at present the largest single construction program remaining in the project. Shasta and Friant Dams, which create the great key storage reservoirs of the project, are completed and in full operation. Keswick Dam, which serves as a regulating structure for Shasta, likewise is in full operation. Shasta and Keswick power plants, with their combined capacities of 450,000 kilowatts, are producing power which soon will drive the project pumps, and service the farms, homes and industries of California. The Contra Costa and Madera Canals, two smaller but highly important offshoots of the project, are completed and delivering critically needed water. Central Valley project water is flowing through the Friant-Kern Canal, the lifeline of the San Joaquin Valley. With the exception of a few small works, this great new, man-made river is complete, to forever change the geography and history of the State.

Thus, in spite of great obstacles over many years, the initial features of the Central Valley project, man's most ambitious attempt to control and beneficially use the fresh waters of the earth, are ready for operation as an integrated unit. It is easy to say that completion of these features was a triumph in engineering. More significant, perhaps, is the acceptance of its broad social and economic aims, best told in terms of an old American concept of economic opportunity against concentration of power, and free access to economic opportunity. THE END.

One Hundred Years of Irrigation

(Continued from page 161)

legislature for approval in 1933. The people of California in December 1933 approved by a narrow margin the right of the State to issue bonds for financing the construction of the project. Because of the depression the bonds could not be sold and aid was solicited by the State from the Federal Government. After a number of proposals and counterproposals were presented, the President of the United States authorized in December 1935 the construction of the Central Valley project as a Federal Reclamation project to be operated in accordance with Reclamation law. Plans and construction on the initial features progressed steadily. In 1944 the two key structures, Friant and Shasta Dams, were completed and put in operation. With the completion of the Delta-Mendota Canal, Delta-Cross Channel, Tracy pumping plant, and the Friant-Kern Canal this summer, water from the Sacramento River will be exported to the San Joaquin Valley, and a plan which was conceived almost three-quarters of a century ago will be put into operation.

Although complete integration of all the irrigation facilities of the Central Valley project is being celebrated this August 1951, portions of the project have been in operation for varying periods of time. The Contra Costa Canal was the first unit put into operation when it began service to the Contra Costa area in August 1940. Early deliveries were primarily for municipal and industrial users. However, small areas of land conveniently located to the canal received the first project water for irrigation. The future will see a vast increase in lands irrigated by CVP. THE END

NOTES FOR CONTRACTORS

Contracts (over $100,000) Awarded During June 1951

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contrac amoun
DS-3291	Central Valley, Colo.-Big Thompson, and Missouri River Basin, Calif., Colo., and Wyo.	June 21	6 5,000-kilovolt-ampere mobile unit substations for emergency power supply.	Westinghouse Electric Corp., Denver, Colo.	$559, 7
DC-3330	Missouri River Basin, Wyo.	June 28	Construction of earthwork, structures, and surfacing for the relocation of 6 miles of State highway (U. S. 14), Keyhole Dam Reservoir.	Knisely-Moore Co., Douglas, Wyo.	299, 5
DC-3348	Eklutna, Alaska	June 6	Construction of 15.2 miles of Eklutna-Palmer 115-kilovolt transmission line, 1 mile of 12.47-kilovolt distribution line, and an electrical distribution system for Eklutna Government camp.	Wiggins Constructions Co., and Morrison-Knudsen Co., Inc., Anchorage, Alaska.	395, 1
DC-3356	Columbia Basin, Wash.	June 5	Construction of earthwork, asphaltic membrane lining, pipelines, and structures for 81 miles of area E-3 laterals and sublaterals, East Low canal laterals, schedule 1.	Minnis & Shilling and United Concrete Pipe Corp., Baldwin Park, Calif.	1, 424. 9
DC-3357	Kendrick, Wyo.	June 25	Furnishing and installing two 18,950-kilovolt-ampere vertical-shaft generators for Alcova power plant.	Elliott Co., Jeanette, Pa.	887, 9
DS-3359	do	June 21	2 26,500-horsepower vertical-shaft hydraulic turbines for Alcova power plant.	Newport News Shipbuilding and Dry Dock Co., Newport News, Va.	496, 8
DS-3361	Central Valley, Calif.	June 25	48 vertical-shaft turbine-type pumping units for pumping plants S4, S5, S6, S7, S8, S9, S12, S13, and S14 on laterals 124.5E, 127.7E, and 130.4E, unit 3, Southern San Joaquin municipal utility district, Friant-Kern Canal distribution systems.	Berkeley Pump Co., Berkeley, Calif.	207, 9
DS-3370	Davis Dam, Ariz.-Nev.	June 6	4 new sets of windings for bank No. 3 power transformers at Phoenix substation.	General Electric Co., Denver, Colo.	132, 1
DC-3373	Missouri River Basin, N. Dak.	June 21	Construction of 43 miles of Bismarck-DeVaul 69-kilovolt transmission line.	Williston Construction Co., Williston, N. Dak.	285, 3
DC-3375	Gila, Ariz.	June 29	Construction of earthwork, canal lining, and structures for Mohawk Canal and Tyson protective dike and outlet channel.	Marshall, Haas & Royce, Belmont, Calif.	1, 719, 3
DS-3386	Colorado-Big Thompson, Colo.	June 14	1 vertical-shaft pump turbine, 370 cubic feet per second at 240-foot head, and 1 13,000-horsepower vertical-shaft synchronous motor for Flatiron power and pumping plant.	Allis-Chalmers Manufacturing Co., Denver, Colo.	373, 4
DC-3387	Missouri River Basin, S. Dak.	June 11	Construction of 109 miles of Rapid City-Wall-Midland 115-kilovolt transmission line.	R. N. Campsey Construction Co., C. F. Lytle Co., and B & C Construction Co., Denver, Colo.	1, 159, 6
DS-3389	Cachuma, Calif.	June 1	4 50- by 30-foot radial gates for Cachuma Dam spillway, item 1.	Berkeley Steel Construction Co., Berkeley, Calif.	224, 0
DS-3391	Missouri River Basin, S. Dak.	June 29	Galvanized-steel double-circuit towers and appurtenances for Oahe-Fort Randall-Sioux City 230-kilovolt transmission lines.	American Bridge Co., Denver, Colo.	4, 178, 1
DS-3392	Missouri River Basin, N. and S. Dak.	do	Galvanized-steel single-circuit towers and appurtenances for Bismarck-Mobridge-Oahe 230-kilovolt transmission lines, Garrison Dam approach spans, and ties to switchyards between Oahe and Sioux City.	Bethlehem Steel Co., Bethlehem, Pa.	1, 694, 5
DS-3400	Central Valley, Calif.	June 5	Construction of earthwork for powerhouse, warehouse, and penstock fabricating areas, tailrace channel, and tailrace channel access road, Folsom power plant.	Guy F. Atkinson Co., South San Francisco, Calif.	1, 463, 7
DC-3408 and DC-3409	Missouri River Basin, N. and S. Dak.	June 29	Constructing foundations, erecting steel towers, and stringing conductors and overhead ground wires for 167 miles of Bismarck-Mobridge-Oahe 230-kilovolt single-circuit transmission line and 135 miles of Fort Randall-Oahe 230-kilovolt double-circuit transmission line.	Hallett Construction Co. and Continental Co., Crosby, Minn.	5, 375, 1
DC-3417	Rio Grande, N. Mex.	June 26	Construction of 53 miles of Belen-Willard 115-kilovolt transmission line using overhead ground wires for entire length of line, schedule 1.	Malcolm W. Larsen, Denver, Colo.	399, 2
DS-3420	Missouri River Basin, Nebr.	June 25	3 radial-gate hoists, 1 lot of wire ropes, sheaves, sheave supports, and 1 lot of floats and accessories for Trenton Dam spillway.	Northwest Marine Iron Works, Portland, Oreg.	104, 77
DC-3431	Colorado-Big Thompson, Colo.	June 29	Construction of steel penstocks and manifold and concrete penstock structures for Pole Hill power plant and Flatiron power and pumping plant, schedules 2, 4, 6, and 8.	Southwest Welding & Manufacturing Co., Alhambra, Calif.	4, 284, 51
DC-3434	Missouri River Basin, Mont.	do	Construction of Canyon Ferry-East Helena 115-kilovolt parallel transmission lines, each 8 miles long.	Askevold Construction Co., Inc. and Darnell Construction Co., Missoula, Mont.	215, 38
DS-3438	Columbia Basin, Wash.	do	10 horizontal-shaft centrifugal-type pumping units for Babcock pumping plant, W35.9 pump system, West Canal laterals, area W-8.	Economy Pumps, Inc., Hamilton, Ohio.	139, 18
DC-3439	Missouri River Basin, Wyo.	do	Construction of 10,000-kilovolt-ampere Lovell substation	McClellan & MacQueen, Inc. and Van Dyke Co., Worland, Wyo.	109, 82
DC-3441	Colorado-Big Thompson, Colo.	do	Construction of earthwork, canal lining, and structures for Horsetooth feeder canal.	Winston Bros. Co., Monrovia, Calif.	1, 149, 21
DC-3442	Columbia Basin, Wash.	do	River channel slope protection at Grand Coulee Dam	Pacific Bridge Co., San Francisco, Calif.	2, 199, 80
DC-3453	Shoshone, Wyo.	do	Construction of earthwork, asphaltic membrane lining, and structures for C-J Coulee crossing relocation, Willwood Canal, schedule 1.	Long Construction Co., Inc., Billings, Mont.	120, 98
DC-3454	Missouri River Basin, S. Dak.	June 28	Construction of Huron, Mount Vernon, Sioux Falls, and Watertown substations.	D. L. Varney, Inc., Omaha, Nebr.	470, 90
DC-3425	Missouri River Basin, Nebr.-Kans.	June 27	Construction of 16 miles of Courtland laterals, sublaterals, and drains.	Pecos Valley Construction Co., Carlsbad, N. Mex.	174, 16
100C-121	Hungry Horse, Mont.	June 1	Earthwork and structures, except bridges, West Side Forest Service Road, schedule 1.	Hoops Construction Co., Twin Falls, Idaho.	953, 50
100C-121	do	do	Earthwork and structures, except bridges, West Side Forest Service Road, schedule 2.	Miller and Strong, Inc., Eugene, Oreg.	1, 179, 41
200C-159	Cachuma, Calif.	June 21	Clearing Cachuma Reservoir site	H. B. Adair Construction Co., Gardena, Calif.	273, 70
300C-24	Davis Dam, Ariz.-Nev.	June 20	Construction of service buildings and area improvement at system O&M area at Phoenix and Parker Dam Government camp, schedules 2, 4, 5, 6, 7, and 8.	Daum-Donaldson Construction Co., Phoenix, Ariz.	106, 80

Construction and Materials for Which Bids Will Be Requested by October 1951

Project	Description of work or material
falo Rapids, Mont	Construction of drains and related structures for area 2, first division, near Glendive, Mont.
huma, Calif	1 42- by 28-inch venturi with meter, 36-inch tube valve, and 30-inch gate valve for Tecolote tunnel.
Do	1 24-inch butterfly valve with controls for Glen Anne Reservoir.
tral Valley, Calif	8 vertical-shaft, propeller-type pumping units and three vertical-shaft, turbine-type pumping units for Sausalito irrigation district laterals.
Do	86 gate and swing check valves for distribution pipe lines, from 10 to 16 inches in diameter, for Southern San Joaquin municipal utility district.
Do	1 350-ton bridge-type traveling crane for Folsom power plant.
Do	3 oil-pressure, actuator-type, 261,000-foot-pound capacity governors for the 74,000-horsepower turbines for Folsom power plant.
Do	1 20,000-kilovolt-ampere and 2 5,000/6,250-kilovolt-ampere transformers for Folsom power plant.
Do	Construction of 102- by 322-foot steel warehouse at Folsom power plant.
orado—Big Thompn, Colo.	Installing package-type substation, at Fort Collins, Colo.
Do	Construction of combination vehicle and power equipment maintenance shop, and a frame building for lumber and cement storage for service area at Loveland, Colo.
Do	Steel discharge pump manifolds for Willow Creek pumping plant.
Do	Installing 10 69-kilovolt switches and lightning arresters and moving 5 69-kilovolt circuit breakers, 1 8,000-kilovolt-ampere transformer, and lightning arresters for Green Mountain switchyard addition, near Kremmling, Colo.
ımbia Basin, Wash	Producing and stockpiling approximately 25,000 cubic yards of crushed rock aggregates for road surfacing materials at Grand Coulee Dam.
Do	Construction of 17 miles of laterals and wasteways in lateral area P-2 on Potholes East Canal, 6 to 10 miles southeast of Othello, Wash.
Do	Drilling 7 domestic water supply wells for operation and maintenance areas in vicinity of Othello and Moses Lake, Wash.
Do	Modification of Pasco relift pumping plant near Pasco, Wash.
Do	Construction of Lower and Upper Saddle Gap pumping plants involving furnishing and erecting a 95- by 25-foot prefabricated steel building and installing pumping units; and construction of PE 17 pumping plant.
Do	Roosevelt memorial at Grand Coulee Dam.
Do	1 1,000-kilovolt-ampere transformer for Ringold pumping plant.
Do	Motor control switchgear for Ringold pumping plant.
Do	Transformers, switching and protective equipment for switchyards for Upper and Lower Scooteney, Lower Saddle Gap, PE 17, and Scooteney relift pumping plant substations and switchyards.
Davis Dam, Ariz.-Nev	Construction of office building near Phoenix, Ariz.
Do	Construction of utilities and surfacing of streets and construction of spur railroad track for system operation and maintenance area near Phoenix, Ariz.
Eklutna, Alaska	2 vertical-shaft hydraulic turbines, each 21,000-horsepower for Eklutna power plant.
Do	Furnishing and installing 2 16,667-kilovolt-ampere generators for Eklutna power plant.
Fort Peck, Mont	Conversion of existing Glendive pumping plant substation from 57- to 115-kilovolt operation, and construction of about 2 miles of 115-kilovolt tap line.
Do	Construction of 115-kilovolt Dawson substation near Glendive, Mont.
Kendrick, Wyo	2 160-inch butterfly valves with control and handling equipment for Alcova Dam.
Do	2 20,000-kilovolt-ampere power transformers, 5 115-kilovolt disconnecting switches, and 2 115-kilovolt circuit breakers for Alcova switchyard.
Lewiston Orchards, Idaho.	Construction of 30- by 80-foot warehouse near Lewiston, Idaho.
Middle Rio Grande, N. Mex.	Construction of 17 miles of Rio Grande River drainage and conveyance channel and levee from San Marcial, N. Mex. to channel headworks.
Do	Construction of 23 miles of Rio Grande River drainage and conveyance channel and levee from Elephant Butte Reservoir to San Marcial, near Elephant Butte, N. Mex.
Minidoka, Idaho	3 11,100-kilovolt-ampere generators for American Falls power plant.
Missouri River Basin, Mont.	Generator voltage switchgear, surge protective equipment, and neutral grounding equipment for Canyon Ferry power plant.
Missouri River Basin, S. Dak.	Construction of 2,000-kilovolt-ampere Wicksville substation.
Do	Construction of 2,500-kilovolt-ampere Wall substation.
Do	Construction of 26,000-kilovolt-ampere Brookings substation.
Missouri River Basin, N. Dak.	Construction of 750-kilovolt-ampere Fort Clark substation.
Missouri River Basin, N. and S. Dak.	Fabricated galvanized structural steel for bolted steel towers for 115-kilovolt single-circuit transmission line approaches to Fort Randall Dam and Garrison Dam switchyards.
Missouri River Basin, Wyo.	Supervisory control and telemetering equipment for controlling Lovell and Thermopolis substations from Boysen power plant.
Okanogan, Wash	Rehabilitation of Conconully dam outlet tunnel and spillway crest about 15 miles northwest of Okanogan, Wash.
Riverton, Wyo	Furnishing and applying asphalt lining on 0.6 mile of Wyoming Canal, second division.
Do	Furnishing and applying asphalt lining on 15.5 miles of Wyoming Canal and 22 miles of Wyoming laterals, third division.
Do	Furnishing and applying asphalt lining on reaches of Wyoming Canal, first division.
Shoshone, Wyo	Construction of waterways for drains in the Heart Mountain division.

United States Department of the Interior
Oscar L. Chapman, Secretary
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Washington Office: United States Department of the Interior, Bureau of Reclamation, Washington 25, D. C.

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THE RECLAMATION AREA

The Reclamation ERA

September
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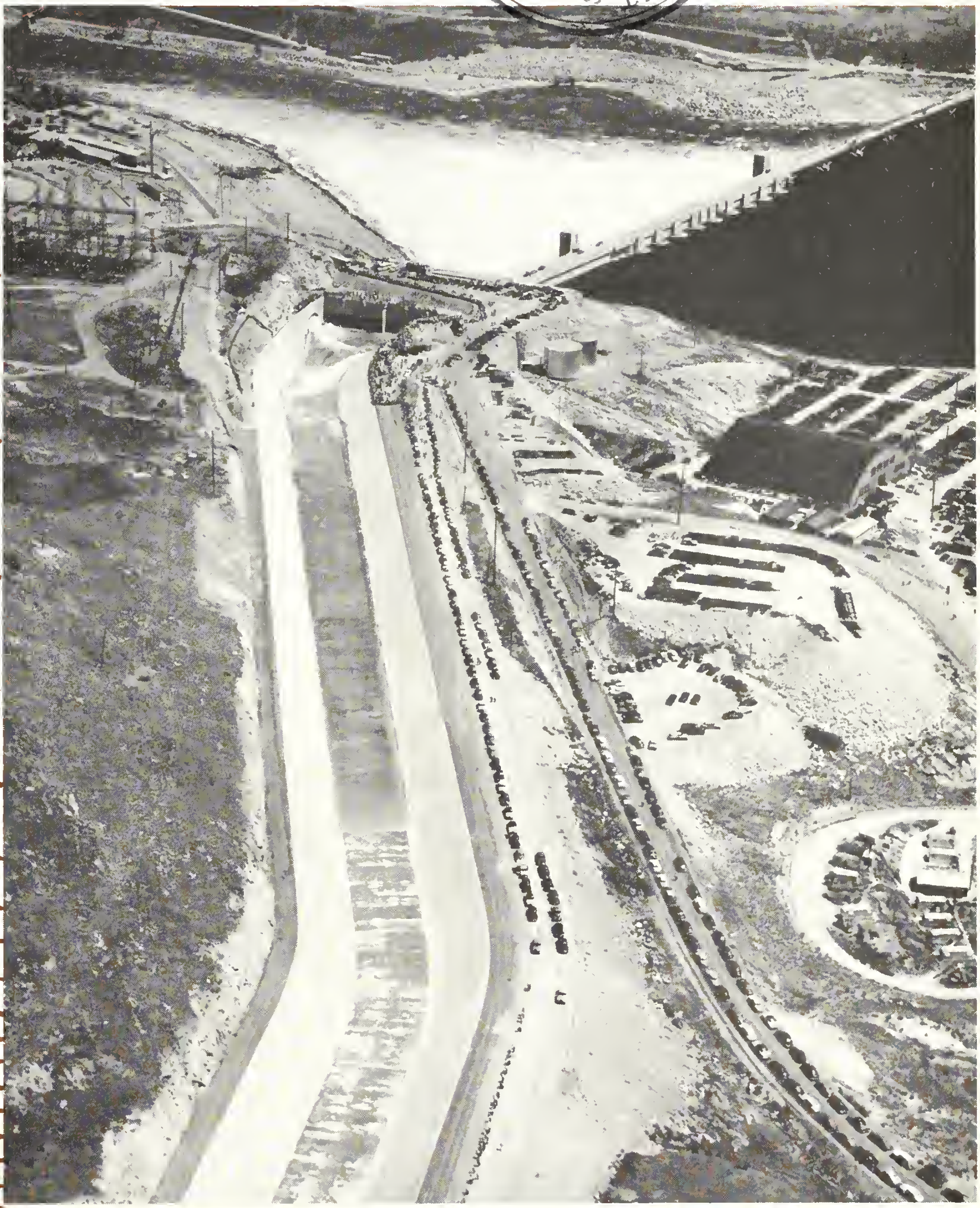

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Ruth F. Sadler, *Editor*

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OUR FRONT COVER

THE BIG LIFT

An aerial view of Columbia River lifting itself by its own power into the largest canal in the world. The canal empties 1.8 miles away into the Grand Coulee, ice-age channel of the Columbia River, which is now the storage reservoir for the Columbia Basin project. Grand Coulee Dam is in the background, 280 feet below the canal. This unusual photograph was taken by F. B. Pomeroy, Region 1 photographer, on June 14, 1951. For more information about the Coulee pumps, read The Big Lift on page 86 of the May 1951 issue, and see Russ DuCette's drawing on page 133 of the July issue.

30 YEARS AGO IN THE ERA

Change in Name of Grand River

Joint resolution to change the name of the Grand River in Colorado and Utah to the Colorado River. (Pub. Res. No. 10, approved July 25, 1921 (42 Stat. 146).

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That from and after the passage of this act the river heretofore known as the Grand River, from its source in the Rocky Mountain National Park in Colorado to the point where it joins the Green River in the State of Utah and forms the Colorado River, shall be known and designated on the public records as the Colorado River.

SEC. 2. That the change in the name of said river shall in nowise affect the rights of the State of Colorado, the State of Utah, or of any county, municipality, corporation, association, or person; and all records, surveys, maps, and public documents of the United States in which said river is mentioned or referred to under the name of the Grand River shall be held to refer to the said river under and by the name of the Colorado River.

(From page 428 of the September 1921 issue of the RECLAMATION RECORD, predecessor to the RECLAMATION ERA.)

RECLAMATION PLACE NAMES IN THIS ISSUE

WATER AND THE WORLD

by WILLIAM E. WARNE
Assistant Secretary of the Interior

By THE END OF THIS CENTURY, or soon thereafter, the world's population will reach 3 billion, according to Julian Huxley, former Director General of UNESCO, unless some unforeseeable force operates drastically to reduce present rates of increase. There is enough food now produced in the world to sustain this number if living were reduced to the Asiatic level, and if all of the world's food were divided equally. But how many people would be willing to accept these provisions?

Subsequent reports by the United Nations confirm Huxley's estimates and state the daily increase at 70,000 people. In terms of numbers, if population increases at the current rate, additional food will be required for 25 million more people each year. In terms of standards, the timetable for increasing food supplies must recognize the desirability of providing decent meals for all who will sit at the world's dinner table.

Of course, we cannot expand the earth's land area from which much of the needed increase in food must come. Of the world's 35.7 billion acres of land, 29.5 billion have suitable temperatures, 22.7 favorable topography, 16.3 adequate soils, and 12.3 sufficient and reliable rainfall.

Consider the interrelationships of these factors. About one-third has suitable rainfall and temperatures. About one-fifth has suitable climate and topography. But only one-fourteenth (about 2.6 billion acres) has that fortunate combination of climate, topography, and soils needed to sustain what we colloquially call a "farm."

Each of these physical factors exercises a "veto" power over all others. The only one we can do much about is the limitation imposed by lack of moisture. Lifting this ceiling through irrigation is, of course, not the only means of increasing food supplies. Improvement of plant strains and other cultural practices will also contribute greatly.

In the whole world, only a little over 200 million acres, or six-tenths of 1 percent (0.006) of the land is irrigated, providing food for about 25 percent of the present world population, and in the western United States, irrigation projects, publicly and privately financed, provide water for farming about 25 million acres of arid and semiarid land.

People usually think of irrigation in connection with deserts, but there are a billion acres of non-desert cultivated lands (called humid and sub-humid) in the world which could be irrigated and provide an enormous increase in the amount of food produced.

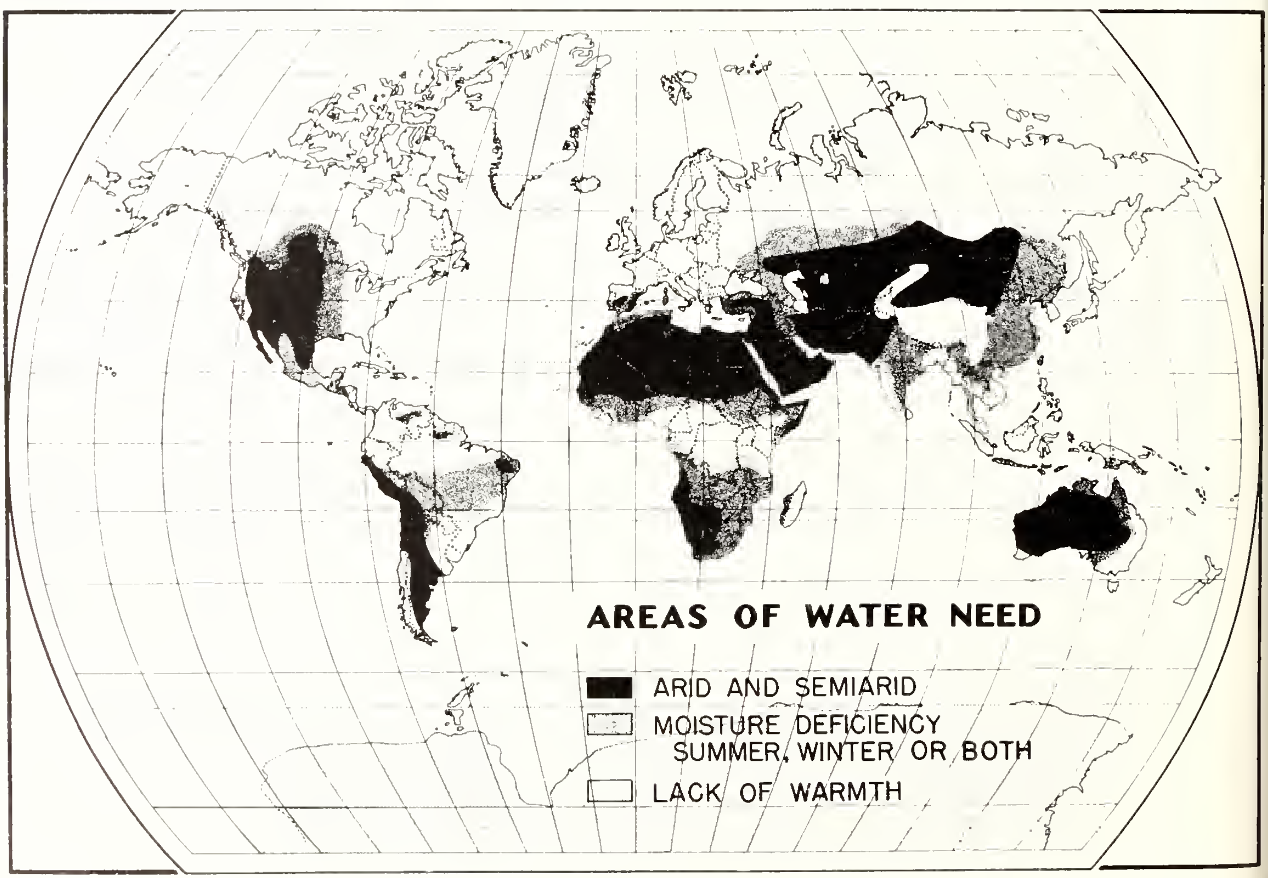
In fact, irrigation of crop land in humid areas already is beginning. Farmers in Iowa or in New York are making irrigation pay, and some of the most expensive irrigation works on record are installed in Panama, where the average annual precipitation is more than 90 inches. Other Central American countries with rainfall of 120 inches and more per year find that irrigation pays dividends.

Small amounts of irrigation water used during periods of seasonal deficiency would expand the selection of crops, and widen the horizons of agriculture, improving both the quantity and quality of crops. Irrigated lands in several parts of Asia produce two crops a year now, and in some of the warmer areas of our own southwest, certain lands are double-cropped. When associated with other cultural practices to protect the land, irrigation can make a contribution in some limited areas by taking advantage of an exceeding long growing season.

Among the principal areas where irrigation should supplement seasonal rainfall deficiencies are those in central South America and in eastern Asia and India. Other large areas in this category are in central and southern Africa, Mexico and adjacent lands of Central America, Asia Minor, and the United States. These areas are indicated in grey on the map below.

About 200 million acres of deserts and near-deserts, where precipitation is too light to permit intensive cropping under natural conditions, might also be developed to add another large volume of food to the world's supply. A much greater acreage can be reclaimed in the enormous area which extends in a broad belt across northern Africa through Asia Minor and on into the heart of China and Siberia. Other such areas are in Australia, in the arid west of North America, and in South America, where inadequate precipitation prevents or greatly restricts formal agricultural operations.

Fifty years of investigations have placed the limit of irrigation feasible under present repay-



ment policies in western United States at about 40 million acres, including the presently irrigated 25 million. Interregional diversions of water, the adoption of new concepts of national responsibility for irrigation, such as that suggested in the report of the President's Water Resources Policy Commission, and advances along the lines of the experiments in rainmaking, or any combination of these, might greatly raise this estimace.

The arid areas of the world which contain the 200 million acres which might be fully irrigated are indicated in black on the map.

To be sure, the irrigation of a billion acres now farmed and the development of 200 million desert acres lie beyond today's economic and political horizons, but it could be expected to double the world's food production. Let me emphasize, however, that both of these totals are estimated in advance of anything like satisfactory world-wide studies.

It would take a great deal of water to irrigate such vast areas, but I believe the water is available, principally in rivers and lakes. The average discharge of the world's 80 major rivers is almost 12 billion acre-feet annually. These 80 rivers include only those which discharge annually at least 10 million acre-feet into the oceans.

There are great diversities in precipitation and runoff among the river basins of the world. Not one single major drainage basin is adequately provided with the rainfall necessary for optimum production throughout its entire area and throughout the whole of the growing season prevailing there.

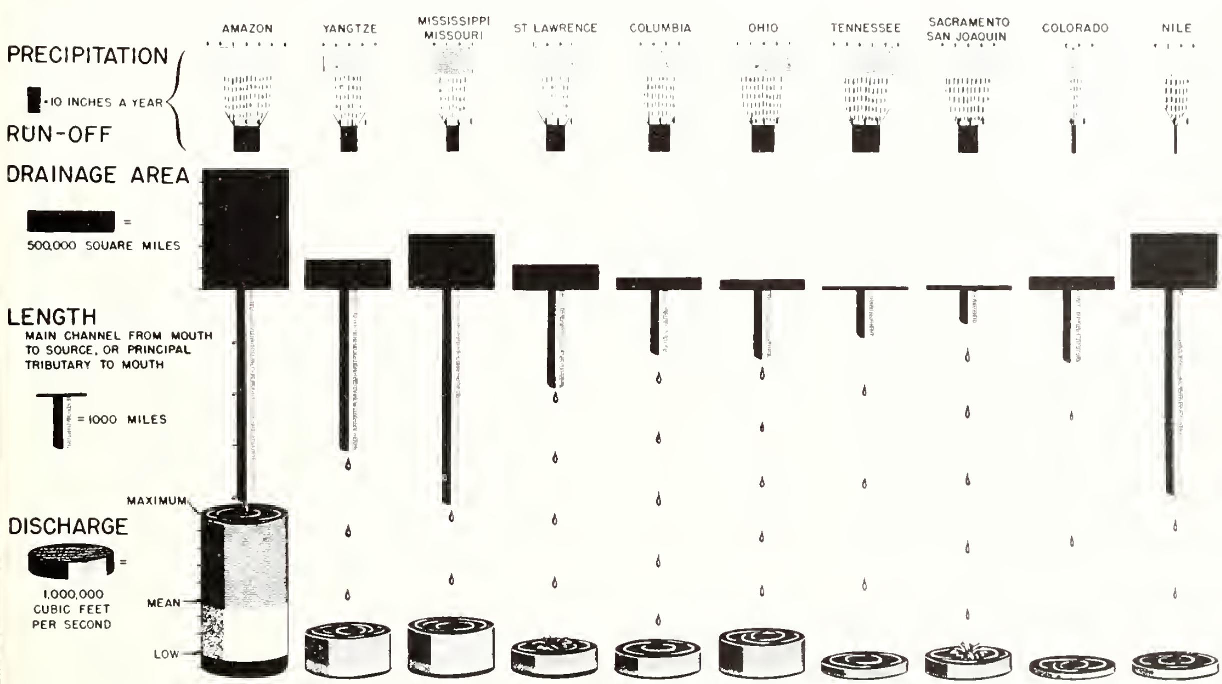
The flow of many rivers varies generally within narrow limits on a day-to-day basis and annually within tremendous extremes. As rule of thumb, the drier the area, the wider the fluctuation both daily and annually.

The chart on this page is a graphic comparison of the characteristics of several of the world's major river basins. It shows rainfall, flow, length of rivers, and size of drainage basins.

Water from wells has been a major source of irrigation supply since the beginning. As the concept of irrigability broadens and expands to include the delivery of supplemental water supply during relatively short periods of deficient natural rainfall, the importance of irrigation pumping from ground water will become more apparent.

The water supplies available in our rivers and lakes may some day be supplemented as technological advancement makes possible the reclamation of sea water for agricultural uses. The ancient art of rainmaking apparently is now being reborn as a science, and from this source some day may come the answer to many water problems. Only in fancy, however, could these possibilities

PHYSICAL AND HYDROLOGIC CHARACTERISTICS OF SELECTED RIVERS



be taken into account today as economic means of increasing the world's food supplies through irrigation.

The orderly development, now in progress in the United States, of river basins provides a pattern which many of the world's rivers could follow. The Food and Agriculture Organization (FAO), one of the specialized agencies of the United Nations, is giving increased attention to water resources for agriculture. The technical program of the United Nations itself is likewise exploring ways and means of helping under-developed countries to put their water resources to work. The Point Four Program of the President is laying heavy emphasis on the study of irrigation and related projects in under-developed areas. Engineers drawn from American industry and governmental agencies are now working under these programs in many parts of the world. Scores of technicians are being trained in the United States and in their own countries under supervision of American experts in the skill necessary to adapt American methods to their own irrigation problems.

There are many problems which will have to be worked out before technical assistance can be fully effective abroad. Among them is the removal of economic barriers which thwart development in many of the smaller nations of the world. Point Four offers a place of logical beginning.

The contribution to the relief of present food shortages in the world and to the meeting of future requirements of a larger world population through assistance in irrigation development is one of the most promising methods by which the United States can contribute to world stability and thus to world peace. THE END.

(The above article is condensed from Assistant Secretary Warne's address at the Second Academic Conference in Northwestern University's Centennial, Evanston, Ill., March 1, 1951.)

Missouri Basin Field Committee Marks Fifth Anniversary

Speaking at an informal meeting in Billings, Mont., on May 23, 1951, Assistant Secretary of the Interior William E. Warne announced, "Five years ago this month the Secretary of the Interior Department signed an order that brought into being the Interior Missouri Basin Field Committee. The purpose of the committee was to coordinate and to integrate the Interior Department programs in the Missouri Basin. During the 5 years of its life, your committee has been instrumental in achieving unity and coordination in the over-all program of the Interior Department for the Missouri River Basin. I congratulate you on your record of achievement."

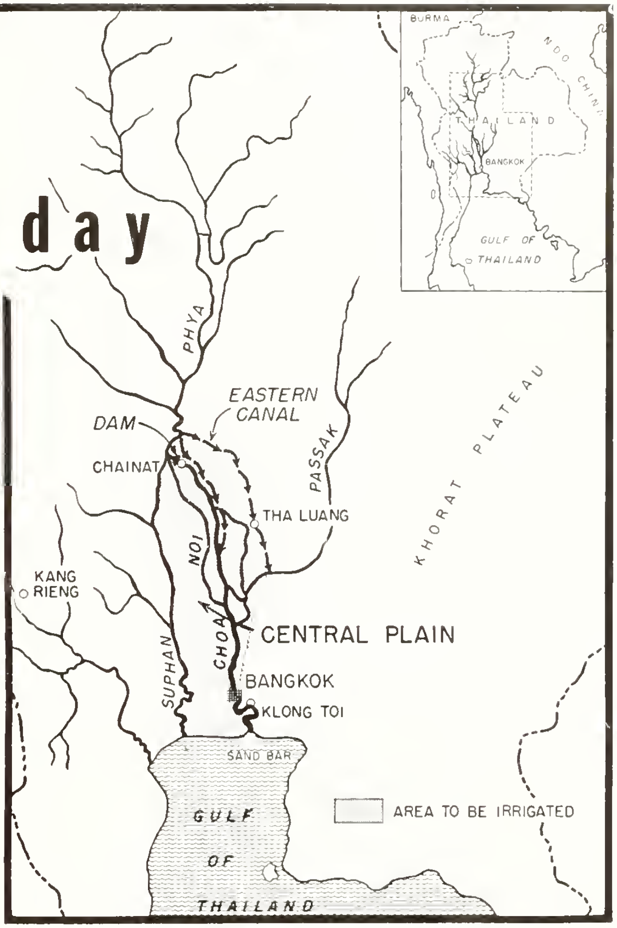
Secretary Warne then recalled the circumstances and events which led to the formation of the Missouri Basin Field Committee and commented that several of the original members were still serving with the committee, among them, H. F. Mosbaugh of Billings, former Supervisor of the Missouri Basin Studies Branch of the Fish and Wildlife Service, who was recently appointed chairman to succeed W. G. Sloan.

The Interior Missouri Basin Field Committee is a part of the coordinating machinery that has grown as a result of Congressional approval of the Missouri River Basin project, a plan for "Conservation, Control and Use of the Water Resources of the Missouri River Basin." Membership of the field committee includes representation from the Bureau of Reclamation, Geological Survey, Bureau of Indian Affairs, Bureau of Land Management, National Park Service, Fish and Wildlife Service, and the Bureau of Mines. It is a voluntary coordinating group, operating at the actual scene of operations. The committee holds about 10 meetings a year at various places in the Missouri Basin.

The field committee roster includes Howard W. Baker, National Park Service; Avery A. Batson, Bureau of Reclamation, Region 7; Henry C. Beckman, United States Geological Survey; Paul L. Fickinger, Bureau of Indians Affairs; Albin D. Molohon, Bureau of Land Management; John S. Gottschalk (acting), Fish and Wildlife Service; G. Warren Spaulding, Bureau of Indian Affairs; Kenneth F. Vernon, Bureau of Reclamation, Region 6; Paul Zinner, Bureau of Mines; and Harrell F. Mosbaugh, Chairman, Department of the Interior.

Today, there are seven Interior Department field committees, covering most of the important river basins in the United States and Alaska. All seven of the committes have been established after the pattern set by the Missouri Basin Field Committee and perform similar jobs.

RECLAMATION in Thailand Today



by M. L. X. KAMBHU, Director General, Royal Irrigation Department of Thailand

As a representative of the Royal Thai Government, I want to say at the outset that we greatly appreciate the cooperation and the technical assistance which we have received from the United States Bureau of Reclamation.

This aid began in 1946. Up to now, 48 Thai irrigation engineers have received most valuable in-service training, in the Denver office of the Bureau's Chief Engineer or in other regional offices. In addition, two experienced design engineers from the Bureau are now assigned to the Royal Thai Irrigation Department on loan through the Economic Cooperation Administration. The Bureau also is advising us on the design of our largest dam, on which we expect to begin construction in 1952.

The kindness shown by the American Government comes at the right time, and for the right purpose. The production of more food is a more pressing matter than ever, and the benefits from the Bureau's work will be immediately, and permanently felt by our farmers, who compose 90 percent of our population.

Although Thailand is situated in the monsoon and typhoon belts, she does not have sufficient rainfall for rice cultivation. The central plain, which is the country's rice bowl, has a rate of rainfall only half as great as those of Burma and Indo-China, because the Malay Peninsula mountain ranges along Thailand's western border check some inflow of orographic rains. Hydrological data for the last 118 years show that there were 4 flood and 56 drought years, in which from a fifth to a third of crops were destroyed. In at least 40 of the remaining 62 years of more or less normal rainfall, some considerable portion of our crops was also damaged, either by the first heavy rains of June, or by mid-season drought in July and August.

Through irrigation and drainage, however, a great deal can be done to stabilize and increase the crop yield. The Thai Government first started modern irrigation work in 1912, but progress was slow. Only 1.4 million acres had been brought under irrigation by 1948. In the meantime the population and the demand for food were increasing.

From 1906 to 1948, the population grew from 8 million to 18 million. Land under cultivation increased from 3.4 to 11 million acres; but much of the new acreage was opened up outside the area of natural inundation. As a result, the average yield of rice dropped from 750 to 450 kilograms per acre. At the same time, Thai exports of rice fell from 1.5 to 1.3 million tons a year. If this trend were to continue, rice annually available for export would amount to only over 1 million tons by 1960; and per capita earnings from the export of rice would be 62 percent less.

During World War II, the food problem was aggravated within Thailand itself. Transporta-

AN EXCHANGE OF SYMBOLS—The author holds a symbol of Thailand's construction program, an important "prime mover" in that country, as Commissioner Straus hands him a symbol of one of the Bureau's greatest structures now under construction—Hungry Horse. The elephant was donated to Commissioner Straus during his recent world tour by a project engineer of Thailand. As a gesture of friendship from the United States, the statue of Hungry Horse was donated to the Director General of the Royal Irrigation Department of Thailand during an official luncheon at the Department of the Interior. *Photo by Glen Peart, Interior Department photographer.*

tion lines were cut, shipments from the rice bowl to other parts of the country were greatly reduced, and in the southern part of the country, near-starvation was the result. It was at this time, roughly a decade ago, that the work of the irrigation department received an impetus which is still carrying us forward.

We began by laying out a program for the kinds of public works we would construct in each of the four major regions of Thailand. Next, we started planning and drawing up estimates for the specific projects which could be undertaken at the end of the war.

Finally, we have begun to create or acquire the elements of manpower, equipment, and financing that are necessary to carry out our program. I might first mention technicians. Since there are very few engineering contractors in Thailand, it is necessary for the department itself to do the construction and maintenance required. A technical school has been established by the department which is now producing about 40 technicians a year. These men can still benefit from more advanced training, so that the opportunities afforded for in-service training with the United States Bureau of Reclamation are most opportune.

In the second place, we need equipment. Thailand has no surplus labor force, since its citizens can earn their living direct from the soil. A force of unskilled workmen is available for only 3 months in the year, between harvest and planting. Therefore, to complete any development project within a reasonable period, equipment is needed to increase the productivity of available manpower. In this connection, it is fortunate that the Thai easily can be trained to be good mechanics, as the ECA has learned.

The ECA grant last year included equipment for carrying out water and soil conservation work in the dry northeastern region of Thailand. With a loan of $18,000,000 made by the International Bank for Reconstruction and Development, we shall be able to buy equipment to be used in the construction of a project on the Chao Phya River, which will make possible proper water control for an area of 2¼ million acres of rice fields in the central plain. It remains for us to buy only the equipment needed in irrigation works in outlying northern and southern regions.

The third necessary element is material. We can obtain an adequate quantity of aggregates, cement and lumber locally, so that only steel is needed from abroad. At the present moment, although supply is rather short, we are able to buy enough for our relatively small needs through the cooperation of the United States, Great Britain, and the countries of Western Europe.

Finally, money is necessary. The Thai administration and parliament have supported the irrigation department vigorously since the end of World War II. Our prewar annual budget was about 3 million bahts. In proportion to the rise in the cost of living, our present budget would be about 40 million bahts; but in 1951, our budget has become 200 million, or five times the expected average.

Thanks to such support, the irrigation department has been able to increase substantially the amount of work done. For instance, during the 30 years before the war, water control was provided for an average of some 47,000 acres a year, or a total of 1,400,000 acres. Since 1947, however,

the average annual rate has risen to 140,000 acres, and the total additional acreage in that relatively short time has risen by 560,000. Now that we are able to carry out larger projects, 2,850,000 more acres will be brought under water control by 1960. The total area under irrigation will be 4,810,000 acres, which is 43 percent of cultivated land.

In the present expansion of irrigation works, the former trainees of the United States Bureau of Reclamation have taken a very active part. Four are heads of divisions, six are heads of projects, and the rest are in designing offices, in laboratories or in other key positions. All of them are competent and efficient, and they are making a major contribution to our undertakings, which long have been needed for the prosperity of the farmers who are overwhelmingly the largest part of our population.

I always try to be cautious about making predictions, yet I feel confident in our ability to complete our projects in good form. We are grateful, I hardly need add, to the United States Bureau of Reclamation and to Commissioner Michael W. Straus for their good will and constant support. In Thailand, we appreciate the importance of making the most of our own resources, and the Bureau's help in enabling us to add to our skills in using those resources is assistance of the very first importance. Perhaps I should add just one more thing—that our story does not end in Thailand itself, for, as our projects materialize, we will be able to increase substantially our exports of rice to friendly Asiatic countries, and to lighten the constant pressure of hunger which bears so heavily on this politically important part of the world.

THE END.

Folsom Power Plant Under Way

Construction work on Folsom power plant, which will add 162,000 kilowatts of hydroelectric generating capacity to the Central Valley project was well under way in July. The Guy F. Atkinson Co. of South San Francisco, Calif., won the $1,463,721 contract for excavating 614,000 cubic yards of material for building a 7,000-foot long tailrace channel for the power plant. A total of 243,000 cubic yards of earth must be excavated for the power plant itself, and 43,000 cubic yards for a tailrace channel access road. In addition earthwork for a penstock fabricating area, and a warehouse must be performed according to contract.

Other contracts have already been let for manufacturing the 74,000 horsepower hydraulic turbines and electric generators to be installed in the power plant.

Folsom Dam is under construction by the United States Army Corps of Engineers, while construction of the power plant and related facilities will be under direction of the Bureau of Reclamation. When the dam is completed, its operation will be turned over to Reclamation as a part of the Central Valley project. •

Palisades Dam Approved as Defense Project

Palisades Dam and power plant on the main stem of the Snake River at Calamity Point, in eastern Idaho, has been approved as a vital defense project by the Defense Electric Power Administration. Construction will commence as soon as funds are available. •

Fly Ash Saves Money and Strengthens Canyon Ferry

A saving of about $625,000 in the cost of constructing the Bureau of Reclamation's Canyon Ferry Dam, the first major unit of the Missouri River Basin project to be placed under construction in Montana, will result from the introduction of fly ash, a waste material from industrial smokestacks, as a component part of concrete and a partial substitute for cement.

Studies by the Bureau's design offices in Denver and actual field operations have proven that ample strength and durability can be obtained at Canyon Ferry Dam by using a mix of 180 pounds of cement and 55 pounds of fly ash per cubic yard of concrete for the interior of the dam and 243 pounds of cement and 82 pounds of fly ash for the exterior of the dam in place of the 376 pounds of cement per cubic yard generally used for concrete in such dams as Hoover, Grand Coulee, and Shasta. Fly ash costs $11.90 a ton delivered at Canyon Ferry as compared to $21.29 a ton for cement—a saving of $9.39 for the substituted material. The fly ash also reduces the expansive reaction between the alkalies in the cement and the aggregate being used, thus assuring a more stable concrete in the dam.

(For further information on fly ash, read the article entitled, "Pozzolan" on page 191, September 1949 issue of the RECLAMATION ERA.)

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WITH THE STROKE OF A PEN a cycle of reclamation activities ends with the signing of a contract by the prospective irrigation water users who will begin another cycle of productivity and prosperity on the Bureau of Reclamation's Angostura unit in southwestern South Dakota. Seated, from left to right, at the contract signing are William B. Engelbrecht, board member of Buffalo Gap, S. Dak.; K. F. Vernon, the Bureau's director for Region 6; Bert Ray, chairman of the board, and C. A. Wilson, attorney for the board, a resident of Hot Springs, S. Dak. Standing are W. J. Burke, the Bureau's counsel for Region 6; Joseph Gamet, board member; E. F. Landerholm, operation and maintenance supervisor for the Bureau's Region 6, and Joseph W. Grimes, the Bureau's district manager for the Missouri-Oahe District, Huron, S. Dak.

ANGOSTURA AGAIN SHOWS THE WAY

by JACK BAILEY, Missouri Oahe District, Huron, S. Dak.

Region 6 (headquarters at Billings, Mont.)

A MILEPOST IN MISSOURI BASIN RECLAMATION was passed at Hot Springs, S. Dak., on May 29, 1951, when water users of the Angostura irrigation district and Bureau of Reclamation officials joined in a ceremony featuring the signing of a repayment contract, thus presaging a more stable way of economic life in southwestern South Dakota.

Through the signing of the repayment contract the way was cleared for building facilities which, within a couple of years, will bring irrigation water from Angostura Reservoir to 12,154 acres of land in the upper Cheyenne River Valley in South Dakota.

The Angostura document is one of the first reclamation repayment contracts executed in Region 6 since work got under way in earnest shortly after World War II on the comprehensive Missouri River Basin project.

K. F. Vernon, Region 6 director for the Bureau, signed the contract on behalf of the United States Government. Almost simultaneously with the contract signing, Chief Engineer L. N. McClellan in Denver announced the award of the contract for the irrigation structures of Angostura unit to Peter Kiewit Sons Co. of Omaha.

Representatives of the Kiewit Co. in attendance at the Hot Springs meeting said that they planned to begin construction in time to be able to deliver water to about 4,000 acres of the unit lands by the beginning of the irrigation season of 1952. The remainder of the land in the Angostura unit is expected to be brought under irrigation by May 1953. About 92 miles of canals, laterals, and other irrigation features comprise the facilities for the unit.

Bert Ray, chairman of the Angostura irrigation district board, and Floyd Haley, board secretary, signed the contract on behalf of the water users. Interested witnesses of the ceremony were Joe Gamet and William Engelbrecht, two other members of the district board, along with W. J. Burke, regional counsel and Ed Landerholm, regional operation and maintenance supervisor,

both of the Bureau's Billings office; Joseph W. Grimes of Huron, Missouri-Oahe district manager; Norval Enger, Hot Springs, acting construction engineer of the Angostura unit, and C. O. Wilson of Hot Springs, counsel for the irrigation district.

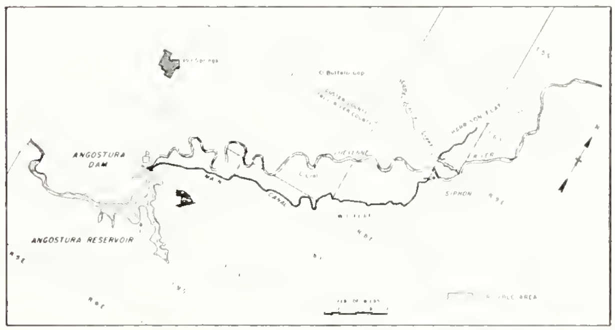
The tone of the meeting was set by board chairman Ray, a bronzed pioneer rancher of the area, in his opening remarks, "We have been waiting a long time for this day to come. For more than 40 years we have been working for it. Damming the Cheyenne and irrigating this land has been a cherished dream of every generation since the 1890's. It appears now that the dream is about to come true."

Representing a much earlier generation which had worked for reclamation for the Cheyenne Valley—a land of sparse population, recurring droughts, crop failures and even grass failures at times—is Mrs. Laura Gamet, now in her nineties. She was not in attendance at the meeting but a good many of those present knew that she would be following the contract-signing proceedings with great interest. Mrs. Gamet is the widowed grandmother of Joe Gamet, a member of the irrigation district board, and spent most of her adult life as the wife of a rancher on lands on or near the unit. She still maintains a lively interest in the progress of the irrigation unit which she and other pioneers, most of them now dead, had expected to come into being many years previously.

Responding to Bert Ray's opening remarks, regional director Vernon said, "Today's action is a major milestone in the history of Angostura. Through this repayment contract Angostura becomes a true and complete representation of the multiple-purpose Missouri River Basin project unit. Because of the partnership entered into today between the landowners and their Government, water conserved and controlled in Angostura Reservoir can be put to beneficial use in the irrigation of about 12,000 acres, thus stabilizing the agricultural economy of this whole area. This project will constitute an island of safety in periods of drought and is expected to increase farm income of the area by $600,000 annually.

"Electrical energy generated by the 1,200-kilowatt power plant under construction at Angostura Dam will provide 12 million kilowatt-hours of

(Please turn to page 196)



"AN ISLAND OF SAFETY in periods of drought"—Regional Director Vernon used this phrase to describe the Angostura Unit, at right, where Peter Kiewit Sons Co. of Omaha is now building the facilities to bring water from the reservoir, shown below, to the 12,154 acres of irrigable land. *Photo by Charles A. Knell, Region 6 photographer.*

CHEMICAL WARFARE against the burrowing rodent colled the gopher is waged relentlessly by William Adam Batzner, below. At right is the old compressor, o length of hose, and a piece of used pipe which comprise the basic elements of his gopher-gassing device. *All photos for this article by Phil Merritt, Region 1 photogropher*

GASSING the GOPHERS

GAS-WORK TAKES THE GUESS-WORK OUT OF KILLING GOPHERS ON CANAL BANKS

by HU BLONK
Regional Information Officer, Boise, Idaho

GENERALLY, WHEN SOMEONE THINKS of some better way to do a job, it's either the result of a desire to make the job easier, to make it safer, or to make more money.

But in the case of William Adam Batzner, it was intense hatred.

"I hate gophers!" said this 55-year-old camp-man at the Bureau of Reclamation field office in the little town of Notus, Idaho, the other day, gritting his teeth in disgust. He so despises them that in the fall of 1949, after trapping them for several years on the canal banks of the Payette division of the Boise project, he perfected a new, modernized method of killing the pests. His ingenuity has resulted in a sizable reduction in the cost of performing this annual maintenance operation.

The new land area, which is Batzner's battleground, embraces 53,000 acres of irrigable land. It is plagued, as are most irrigation projects, by thousands of gophers. They burrow through canal banks and would, if allowed to dig away unmolested, cause costly and perhaps disastrous canal breaks. An old gopher, they say, may dig as much as a mile of tunnel in a year.

Up until about 1½ years ago, Batzner, who was then "official gopher-catcher" on the division, used traps, 60 or more. An expert at the business, he killed as many as 1,330 during one 90-day period. But the process of covering the 500 miles of canals on the division was burdensome, time-consuming, costly, and required handling the pests, which is not exactly a pleasant experience, even for Batzner, who had trapped some 5,000 or more.

Despite his outstanding record, Batzner wasn't satisfied with his yearly kill. He so detested the rodents that he lay awake nights thinking of how

to kill them faster. Today, because of that meditation, the job is being done faster, and cheaper, and cleaner.

The new method employs calcium cyanide powder. These fine particles are blown, under compressed air, into the network of gopher runs, where upon exposure to the moisture in the tunnels, they release hydrocyanic acid, which kills life instantly.

Batzner took an idle compressor from the warehouse at Notus which had been used to pump up automobile and carryall tires, and placed it on a jeep. He fastened about 50 feet of quarter-inch rubber hose to the compressor and at the end of the hose attached an improvised metal chamber to hold the cyanide power and stir it up through the application of air.

The chamber, which was made in about 2 hours, consists of a 6-inch length of 3-inch pipe, welded shut at one end and provided with a screw-cap at the other. Inside this chamber is a quarter-inch valve, which controls the amount of compressed air that may enter and thus regulates the amount of powder that leaves the chamber each time air is admitted. In front of the valve is a jet, which mixes the air with the powder, and behind the valve is a small hole through which the air and powder are blown out through the hose and into the gopher run.

Until Batzner perfected the compressed air device, cyanide gas had been inserted into the runways by means of a hand-pump. This system was only partially successful. The gopher felt the change in pressure of the air each time the pump stem came down and hurriedly threw up an earth bulkhead to protect himself from whatever he felt was coming after him.

The compressed air blows the killing fumes through the runs as fast as 150 feet in $1\frac{1}{2}$ minutes. At the time the photographs accompanying this article were taken, gas was inserted in one gopher hill and in 20 seconds it came out from another hill, opened up for the demonstration, some 60 feet away.

The monetary savings resulting from the improved killing method are easily discernible. Trapping normally required about 60 working days, at a cost of $8.50 per day, or $510 each season. About 60 traps were used, but two-thirds of them were lost during the annual operation. Cats and dogs would carry off gophers and traps, or human beings would steal them. This loss amounted to $32. About 50 miles of driving per day was required, at a cost of 10 cents per mile, or a total of $300. The entire operation cost $842 per year.

Compare this with the present system. A two-man crew can do the job in 10 days at a labor cost of $160. The automobile expense, estimated at 70 miles per day, totals $70. Fifty pounds of calcium cyanide costs $25, making a total cost of $245 per year.

Thus, the savings amount to more than $500 a year. Use of the Batzner-perfected method on projects throughout the West would greatly multiply this figure, of course.

The labor-saving involved is quite evident. Setting two traps in a 150-foot run requires about 20 minutes. Now this area can be gassed in 5 minutes.

EFFICIENT, ECONOMICAL AND EASY—At right, Batzner demonstrates the manner in which the hose is inserted in the gopher hole. During the actual operation, the hole is closed to keep gasses from escaping. At center, below, Batzner shows what happens when a gopher isn't killed.

It will cost the farmer a lot to replace soil lost by water erosion resulting from canal break. Below, the death-dealing metal chamber.

"To trap gophers you've got to be smarter than they are," Batzner said. "They'll see or smell your trap and cover it over with a mound of earth. Then you have to set it over. It all takes time. Then, too, one trap can catch only one gopher. One shot of gas may kill a dozen."

Batzner explained that the gassing is most effective in February or March, when the gopher has its first litter and the ground is damp, thereby sealing in the gas, which normally retains killing power for 2 or 3 days. Fall is the second best period to do the work.

The first step in the operation is to remove the gopher hill with a shovel, and then find and open the hole with a small blade. The hose, provided with a pipe end, is inserted and gas applied for about half a minute. The compressor has a capacity of 125 pounds, about 25 of which are used each gassing. The chamber is filled to about two-thirds capacity. Study of the operation clearly shows that once applied no further activity in the runs treated will be noted.

Batzner is proud of this equipment but he recommends several improvements. For one, he suggests a larger container for the cyanide powder to reduce the time-consuming loading operation, and secondly, he recommends a clear plastic chamber so that the amount of powder inside is always known. Also handling the cyanide powder is dangerous and separately packaged charges for the gun would make the operation safer on windy days.

But even as it is, the device constitutes a noteworthy contribution in the improvement of government techniques by a man who works with his hands but uses his head for thinking. THE END.

Angostura Again Shows the Way

(Continued from page 193)

electrical energy yearly for irrigation pumping and other uses.

"Angostura Reservoir is destined to become one of the most popular recreational areas in southwestern South Dakota. Through the cooperative efforts of the Bureau of Reclamation, the Fish and Wildlife Service, Forest Service, and South Dakota Game, Fish and Parks Commission, fish have been planted in the Angostura Reservoir and boating, swimming and other recreational facilities are being provided as rapidly as possible.

"I know that all of you share with me an appreciation of the true significance of what is taking place here this morning."

The Angostura unit lands are in Fall River and Custer Counties, the former on the south side of the river: the latter on the north. They will be served with water by a 30-mile-long main canal, including a 2-mile-long siphon crossing of the Cheyenne River. The economic history of the area has been one of violent ups and downs caused by recurring severe droughts.

During the drought and depression of the thirties many residents left the area and their land was purchased under the emergency program inaugurated by the Federal Government. Consequently, about 75 percent of the irrigation district land is owned by the United States. The Soil Conservation Service, Department of Agriculture, is preparing this land for irrigation and ultimately will sell it in family-sized tracts to qualified irrigation farmers.

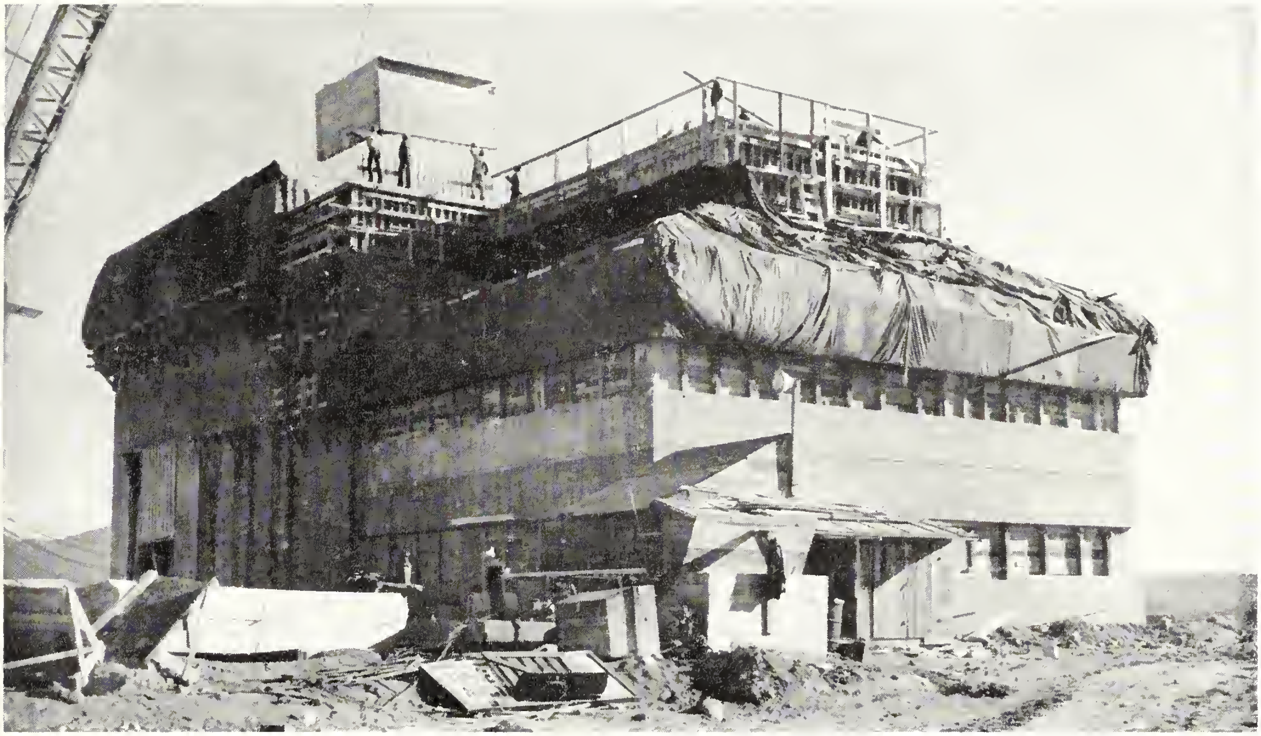
A recent census showed that there are 26 farm-ranch operators living in the unit area. In an election April 17, 1951, on the question of approval or disapproval of the proposed water user's contract, the vote was 22 to 1 in favor of the contract with the Bureau. There were 29 landholders eligible to vote.

With the coming of irrigation, people of southwestern South Dakota are envisaging an influx of population to the district numbering perhaps 500 or more whereas today the rural population is estimated at a total of 120.

Angostura was authorized initially under the Water Conservation and Utilization Act of 1939, as amended, better known as the Wheeler-Case Act. The unit was approved in 1941 but the beginning of World War II prevented initiation of construction. Angostura was included in the Missouri River Basin project authorized by the Flood Control Act of 1944 and was the first multiple-purpose unit of the basin-wide plan to reach the construction stage. Work on the dam which is located 8 miles southeast of Hot Springs, S. Dak., began in the summer of 1946 and the structure was completed in December 1949. Since that time, the water users have been working overtime to perfect their irrigation district program.

So it is that May 29, 1951, becomes another major date in Angostura history. THE END.

(For additional information on the Angostura project read the article entitled, "Angostura Shows the Way," on page 234 of the December 1949 issue.)



GRANBY PUMPING PLANT, the "mainspring" of the Colorado-Big Thompson project, as it appeared 2 years ago this September. Less than a third of the actual structure is built above ground—the rest is subterranean. *Photo by M. F. Burg, Region 7.*

Colorado-Big Thompson's Mainspring

by C. S. SCRIBNER, Field Engineer,

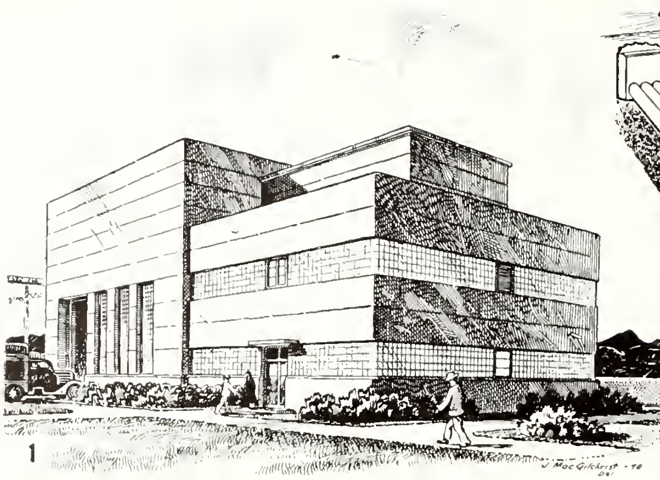
Grand Lake Area, Colorado-Big Thompson project, Region 7 (headquarters at Denver, Colo.)

Just as a mainspring is the motivating force which drives the works of a watch, so is the Granby pumping plant of the Colorado-Big Thompson project the mainspring which will set in motion project works stretching nearly 200 miles across the northern Colorado landscape. Here is forged the first link in a chain of beneficial results that will be bestowed on people and land on the eastern and western slopes of northern Colorado.

The water thus delivered will mean improved crops, which in turn will mean more benefits through profits to the farmer, to the merchant, to the city, to the county, to the State and to the whole country. And what's more, some of the energy produced by the pumped water returns to operate the pumps and thus lift more water. Perpetual motion you might say, but really it is better than perpetual motion, as the water which provides supplemental irrigation for 615,000 acres of land also provides electric power for use by irrigators, municipalities, and local industry.

The Granby pumping plant is located on the western slope of the Continental Divide on the north shore of Granby Reservoir some 100 miles northwest of Denver, Colo. This reservoir has been formed by the construction of the 298-foot high Granby Dam, which is the main storage facility for the Colorado-Big Thompson project, and has a total capacity of 544,867 acre-feet of water. The dam, located so as to intercept the maximum amount of flood water possible in the area, is lower than the Alva B. Adams tunnel which conveys the water to the eastern slope power plants and farm lands. That is why the water must be raised by pumping.

The Granby pumping plant is a reinforced concrete building constructed of some 18,000 cubic yards of concrete and 4,660,000 pounds of reinforcement steel. Its height of 188 feet is the equivalent of a 13-story office building. Only 50



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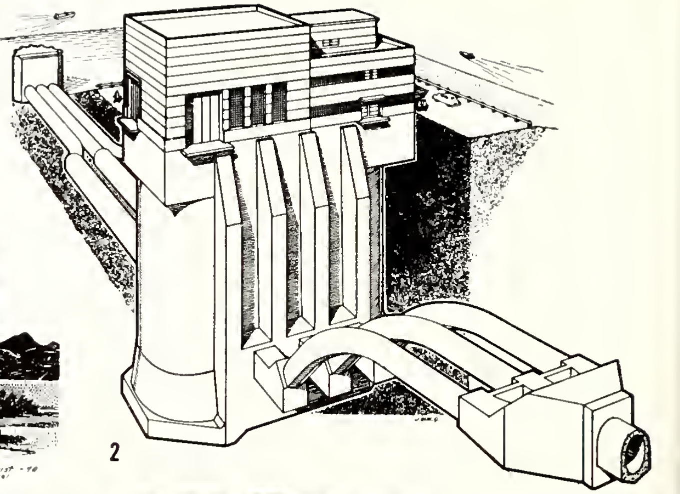

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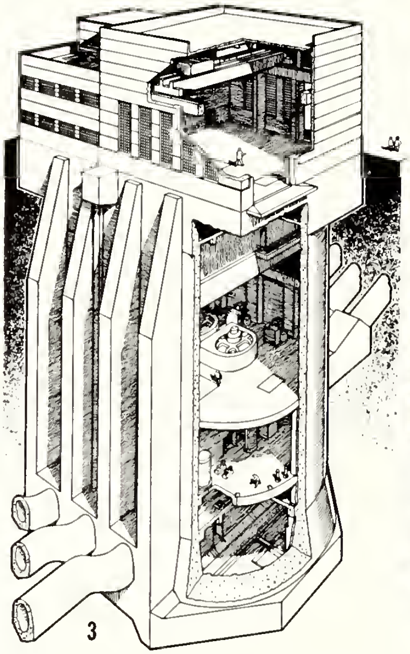
feet of this structure is exposed above the ground; the rest of the building is buried, since the reservoir water surface will fluctuate some 94 feet and the pumps must be located below the lowest level of the water. The three main pumps (each powered by a 6,000 horsepower electric motor) are capable of lifting to a height of 186 feet a minimum of 388 million gallons of water per day. As the reservoir fills, each pump will become more productive and when the reservoir is full, they will be able to lift about 632 million gallons of water each day.

Construction was started in April 1947 for the pumping plant and its related structures by contract with the Granby Constructors, an association of seven contractors combined especially for this job. Before any concrete could be placed, approximately 275,000 cubic yards of earth and siltstone had to be removed to expose a suitable foundation. The work of building the concrete structures, namely, the pumping plant, the intake structure, three intake conduits, each about 518 feet long, and a discharge conduit 3,350 feet long, was started in July of 1947 and substantially completed in November of 1949. After the building had been constructed, backfill was placed around it and up to the level of the main floor, 25 feet above the original ground, and 7 feet above the high water elevation of the reservoir. Since this work was located in a high mountain valley at elevation 8,287, winter came early each year and closed down the contractor's operations. Then, too, since the country had not recovered from the war, many materials were difficult to obtain, but the contractor pursued the work as rapidly as conditions would permit. In March of



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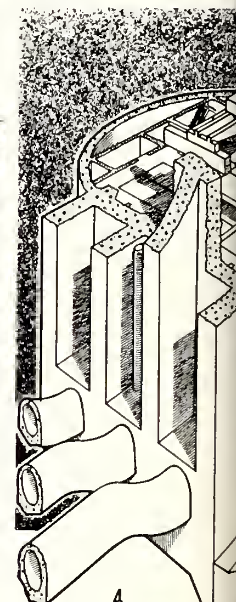

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1950 another contract was awarded to the Eichleay Corp. of Pittsburgh, Pa., for the installation of the main pumps and motors and related machinery. The remainder of the year of 1950 was spent in completing the building and in the early part of 1951 the Granby pumping plant was ready to operate whenever the occasion demanded.

At the top of the hill north of the pumping plant, the discharge conduit terminates in a siphon-breaker house at the head of the Granby pump canal. The water discharged here flows by gravity through the 1.8 miles of the Granby pump canal, through Shadow Mountain Reservoir, through Grand Lake and into the 13.1 mile long Alva B. Adams tunnel under the Continental Divide (reputed to be the longest irrigation tunnel

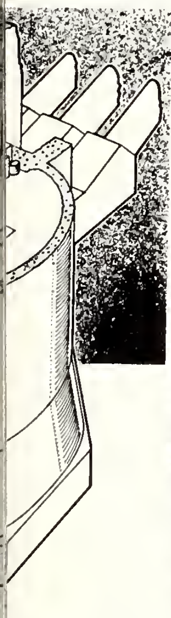
in the United States and to be the longest ever constructed exclusively from two portals). After passing through the tunnel, the water drops 3,000 feet, passing through four power plants before being stored in foothills reservoirs, until it is needed for irrigation by the farmers. By dropping this water through the power plants, electrical energy is produced for operating the project pumps and for general use.

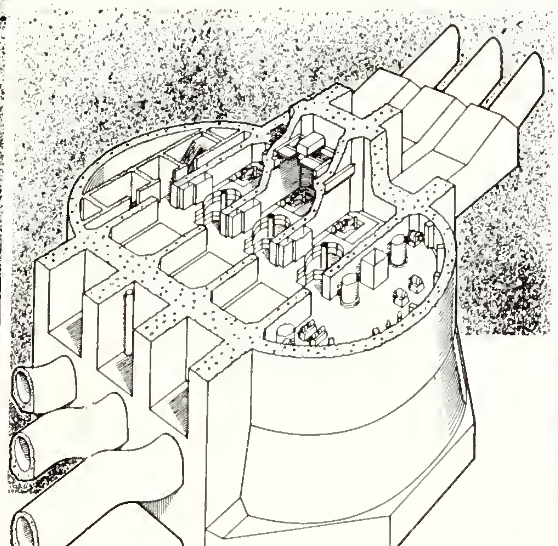
Coming back to the "mainspring," the pumping plant building is uniquely designed. The lower portion of the building, instead of being a conventional rectangular shape, like the portion exposed above the ground, has straight side walls and semicircular ends. The side walls are constructed of concrete 5 to 6 feet in thickness and braced by massive buttresses. The semicircular arched end walls are, however, only 3½ feet in thickness. This type of construction was found to be the most economical to withstand the tremendous pressures of the earth fill and reservoir surrounding the building and still provide a workable arrangement in the plant.

On the highest floor at elevation 8,315 is the hoisting apparatus for the elevator which serves the entire building.

On the floor below at elevation 8,301 but still above the ground, are the station service control room, the battery room, and a room containing part of the ventilation fans and heaters.

Next is the main floor, at ground level, where the main control room, the machine shop, a 50-ton





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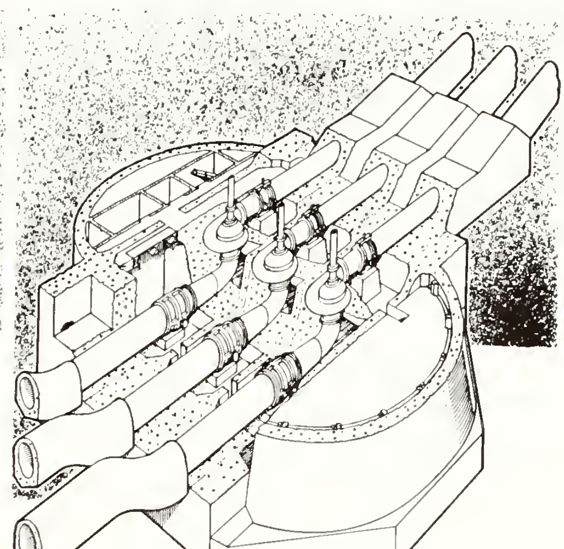

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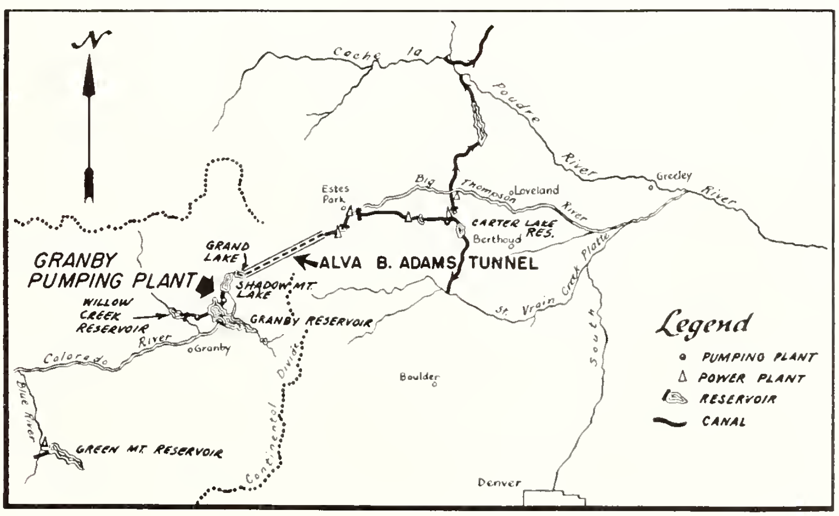
H MORE THAN MEETS THE EYE is revealed in s cutaway drawings of the subterranean Granby ing plant. The "penthouse" in figure 1 con- the hoisting apparatus for the elevator, while e floor below is the station service control r Figure 2 is another view of the 188-foot-high ire, showing how water is taken from Granby voir through the plant to the outlet pipes in the ound. Figure 3 gives a glimpse of the main with its 50-ton traveling crane which can reach into the lowest parts of the plant for machinery d of repair or replacement. This drawing also away the walls to show the floors beneath d level—a tiny black section representing the room, below that the store room, a slice of otor room, and a man at work in one of the rooms. At the bottom are the floors for pump- ut seepage water and keeping the pumps in condition. Figure 4 represents the motor showing a hatchway being lifted by a 25-ton at this level. Figure 5 is the floor with the rooms, each with its pump shaft and butterfly control system. Figure 6 shows the arrange- of the pumps and the butterfly valves.



traveling crane, tool rooms, first aid room and the lavatories, are located. Hatchways (openings in the floor covered with removable steel covers) through all of the floors enable the traveling cranes to move machinery to any level in the building. The main control room contains all of the controls needed to operate the pumps, and also the radio and carrier current telephone which are used for transmitting instructions in the regulation of water and power for the project. Another feature of this room is the remote control board for regulating the spillway gates at the Shadow Mountain Dam over a mile distant, and intake gates at the Adams tunnel about 7 miles away. It is possible to regulate the flow of water into the Adams tunnel and in Granby Reservoir from the Shadow Mountain Reservoir by these controls. The floor immediately below the ground surface where the cable spreading room is located is at elevation 8,272. The power to run the pumps comes from the Green Mountain and the eastern slope power plants through 69,000 kilovolt transmission lines to the switchyard northeast of the building. The power transformers in the switchyard step-down the voltage to 6,900 volts for the pump motors, and power is carried to the building through cables in a connecting underground tunnel into the cable spreading room. This room might well be compared to a nerve center of the human body, as power is distributed from here to the entire building by means of cables in the vertical cable shaft which goes down through the building, and through conduits, other shafts and openings to the upper rooms. Also on this floor is another ventilation fan, the air compressors for service to the building, the water filtering and oil filtering room, the oil storage room and two (4,500 gallons per minute) turbine-type deep well pumps for unwatering the plant in case of flooding. Ample space has been provided in order that the power transformers may be brought in and set down on this floor and serviced.

The next floor at elevation 8,252 is for the storage of spare parts and supplies.

Immediately below this floor is the motor room at elevation 8,211. It is a most impressive room with the three completely housed 6,000 horsepower motors, their excitation equipment in adjoining cabinets and a 25-ton crane which serves this and the lower floors. The motor room, 76 feet underground, is large and spacious.

On the next floor, at elevation 8,186, are three nearly identical rooms each containing a pump with the top of the pumps and the shafts connecting the motors to the pumps visible. Adjacent to each pump is the discharge butterfly-valve control system which controls the valve between the pump and the discharge conduit. This control automatically closes the valve when pumping is interrupted by power failure. Each pump will turn 327 revolutions per minute while operating. By looking through the gratings set in this floor, it is possible to see both the discharge and intake butterfly-valve housings, which are eight and nine feet in outside diameter. One small crane serves this floor and may be moved from bay to bay by using the 25-ton crane located on the floor above.

Other floors below this level permit access to the valves and to the sump room where miscellaneous seepage water from the building is collected, pumped to the ground surface and discharged back into the reservoir.

Thus another completed step brings closer the great objective of the Colorado-Big Thompson project, which is to use beneficially the surplus water from the reaches of the Colorado River above elevation 8,280 for the purpose of supplementing the inadequate supply of irrigation water to farm lands lying below elevation 5,400, while at the same time developing greatly needed electricity for domestic and industrial use from the energy of that water dropping more than 3,000 feet between the supply and utilization areas on the eastern side of the Rockies. THE END.

Frenchman Cambridge Contract Confirmed

Final confirmation by the District Court of Red Willow County, Nebr., of a water service and repayment contract between the Federal Government and the Frenchman-Cambridge irrigation district has cleared the way for accelerated work on irrigation phases of the Missouri River Basin reclamation project in that State.

The authority of the Secretary of the Interior to negotiate a contract to furnish a water supply for irrigation purposes under the provisions of section 9 (e) of the Federal Reclamation Project Act of 1939, which had been challenged by a water-user, was upheld without change by the court as not in conflict with Nebraska State law. ●

THE ITALIAN PEOPLE follow mission team investigating canal in San Giovanni in Fiori, southern Italy (at left). A mission investigator and Italian officials of the Caulonia project, below, at the project's mill where peasants bring their wheat and do their washing.

Reclamation Under The Marshall Plan in Italy

by W. E. CORFITZEN, Reclamation Specialist, Economic Cooperation Administration, Rome, Italy

PART 2—THE WORKING PLAN

EDITOR'S NOTE: In the July 1951 issue, Mr. Corfitzen outlined the beginnings of the plan devised for rapidly improving the Italian national economy, described the problems facing the Italian people following World War II, and explained how a general criterion was established that only projects would be considered which would guarantee a maximum production of food in a minimum amount of time with a minimum amount of money. In the following pages he goes further into the manner in which the plan was worked out.

AS A FIRST STEP in the investigation of the program, the mission requested that a report be prepared on each project which would include separate sections on engineering, agriculture, and economics. The reports were translated and discussed with Government officials, following which a field inspection trip was made to each project.

A field investigation was carried out by calling a meeting of the project officials, including the technical staff. This meeting was generally attended by many more people than would be the case in the United States. Besides local farmers, the prefect, the mayor, other high officials of the national or local government, representatives of local cooperatives, unions, and similar organizations were present.

A representative of the mission briefly outlined the program of ECA assistance to Italy and what role reclamation played in the over-all program. The economic aspects of reclamation work were then stressed and emphasis laid upon the fact that we were more interested in the early production of food than in long-range projects or in features that would have no immediate bearing upon food production.

The project engineer was then requested to describe the project briefly, to show what had been accomplished since the project was originally constituted, and to explain in detail what work was planned for the period of ECA assistance, with particular emphasis upon features to be constructed with funds from the 1948–49 Counterpart Lira Fund.

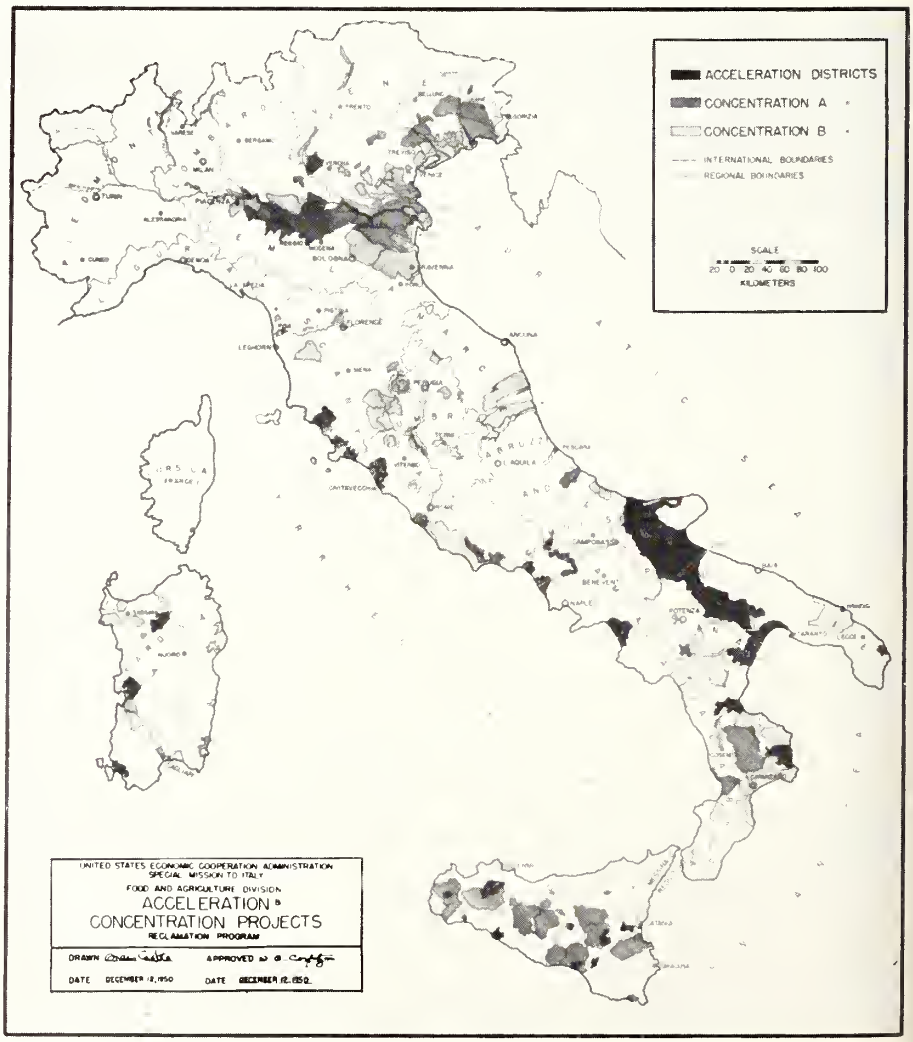
After a complete discussion of the engineering and agricultural aspects, a trip was made over the project area by car and on foot to examine the site of every major feature as well as those of many minor structures and canals. Such detailed checking made it possible for mission investigators

to observe the project staff which would have the responsibility for performing the proposed work and to evaluate what the staff had already accomplished over past years in a known amount of time and with a known amount of money. It also made possible the observation of actual field conditions relating to soil, cultivating, and harvesting methods, and enabled us to ascertain the probabilities of success in the agricultural program proposed.

This type of investigation was of infinite value in many ways. Government officials who in the past rarely had an opportunity, owing to the pressure of their administrative duties, to visit the field projects, accompanied members of the mission and took part in discussions involving thousands of questions relating to almost every conceivable agricultural and engineering aspect of the many projects. Of particular interest and value to the investigating team were the views of, and discussions with, project officials and farmers scattered throughout Italy.

Italian groups became acutely aware of the weight which the mission gave to the economic aspects of projects and particularly to the cost-benefit ratio which the mission insisted must always be favorable before a project could be approved. Mission representatives, on the other hand, became aware of a great difference which exists in the thinking and the preparation of reports between American and Italian engineers and agriculturists.

Justification for many of the Italian projects was founded almost entirely upon social or political aspects while the economic aspects were often underrated. The social and political aspects, of course, could not be neglected, because this nation of 46,000,000 people (density=151 per square kilo-



ITALY'S RECLAMATION PROGRAM as delineated on the map at right, submitted by the author, is divided into three categories. Projects along the coast and in the southern part of Italy are being given the acceleration treatment. This group includes 30 projects which are receiving ECA assistance for 4 years. Concentration A includes 48 projects which require ECA assistance to complete them and bring them to full productivity. There are 121 projects in Concentration B which will receive ECA money for 1 year, after which time the Italian Government plans to obtain funds from the regular budget to complete any work left unfinished.

meter) emerged from a world war with serious unemployment and attendant social problems. Mission investigators, therefore, obtained a real appreciation of the social aspects of unbelievably depressed areas and of the economic and social benefits inherent in employing large groups of men to do what a few machines ordinarily would do if the work were in the United States.

Upon completion of the field investigation, a detailed project report was prepared by the reclamation specialist, describing the project, drawing conclusions and making specific recommendations.

On the basis of these recommendations, funds were allocated from the Counterpart Lira Fund to the Ministry of Agriculture for release to specific projects. These projects were scattered throughout the Italian mainland and the islands of Sardinia and Sicily, as shown on the map, and involve three categories of projects: Acceleration, Concentration A, and Concentration B, which are a sort of priority assigned to the projects, but difficult to apply rigidly because of social aspects involving the need for employment on construction jobs.

These categories were defined as follows: ACCELERATION—projects constructed under a specific Italian reclamation law which provides for government assistance to reclamation features of certain specifically designated reclamation projects. The law provides that private landowners shall be notified that the government will construct certain reclamation works and that the owners of private lands must make provision to utilize fully the works provided by the government. If the landowners fail to develop their lands, the government has the power to expropriate the lands for public development. This group included 30 projects which would receive ECA assistance for 4 years (1948–52).

CONCENTRATION A.—This group involved 48 projects which also receive ECA assistance for a 4-year period. In general, the Concentration A group represents projects where both the government and private owners have achieved considerable success through works already accomplished in the reclamation field and where a concentration of funds is believed to be all that is now required to complete the projects at an early date and to bring them to full productivity. No provision is made in this group of projects for the expropriation of land as private owners have for the most part utilized the works already provided by the government and are fully cognizant of the benefits which may be derived through drainage and irrigation.

CONCENTRATION B.—This group consists of 121 projects and is similar to the Concentration A group with the exception that funds from ECA sources would be made available for 1 year only because the Italian Government believes that following 1 year of ECA assistance it would be possible to obtain funds from the regular budget for completion of those features not completed with ECA funds. It was believed that ECA assistance would make it possible to complete about 90 percent of the work required on this group of projects.

In addition to the above three principal phases of the reclamation program, there were three other categories: Antimalaria, war damages, and mountain basins.

The antimalaria program was originally conducted as a part of the reclamation program in Italy and the Ministry of Agriculture was in charge of the works carried out. This was a very natural corollary of the reclamation program because the large areas to be drained were also infested with the Anopheles mosquito, which caused widespread malaria, and malaria control naturally became part of the reclamation program. These works generally included drainage canals, the elimination of stagnant water, and a procedure for spraying open bodies of water.

More recently, with the discovery of DDT, the campaign has been transferred to the High Commissioner for Hygiene and Public Health and the attack is now directed against the Anopheles mosquito through such action as the spraying of all bedrooms, kitchens, barns, etc., with a 5-percent DDT solution. In this way it has been found that mosquitoes have been eradicated before the eggs are laid with a consequent reduction in the number of larvae found in samples taken from stagnant pools and other mosquito breeding places.

(NEXT MONTH—COSTS AND BENEFITS OF THE PROGRAM)

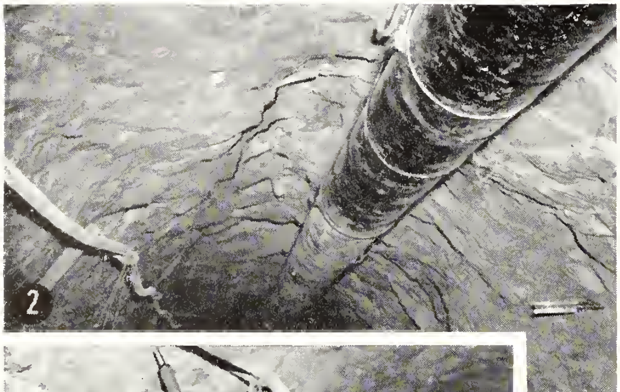
NEXT MONTH

FORT SUMNER FORTIFIED

also

FARM AND PHEASANTS

How Reclamation Aids Wildlife Conservation and Development



ROOF BOLTS FOR DUCHESNE

Part of Duchesne tunnel's roof is "holding itself up by its boot straps."

At least that is the term once used by skeptics who doubted the effectiveness of the technique used for supporting a 200-foot section of this "problem child" among tunnel jobs.

Roof bolts are making one particular section of this tunnel in the Provo River project of Utah self supporting. They also have additional advantages—they are permanent; do not deteriorate or have to be replaced; they are not easily dislodged by blasting or moving equipment; they improve ventilation; give more overhead and side clearance, improve housekeeping, eliminate the need for storing bulky material, and are cheaper than conventional steel supports.

The principle of roof bolts might be illustrated by visualizing a loose stack of lumber suspended between two sawhorses, about 7 feet apart. What happens? The lumber sags in the middle, curves up at the ends, and if it is at all dry or has any imperfections, it splinters and sometimes cracks under the strain. But if you tie the lumber together, by driving bolts through it, you have a strong, straight, stack of lumber. Substitute the solid walls of the tunnel for the sawhorses, and the layers of rock making up the tunnel roof for the lumber, and you have the principle of the roof bolts, and an explanation of how these "sky hooks" hold the roof up safely. Actually, they reinforce the "skin" of the arch and hold the layers of rock strata so closely together that the planes can neither separate, spread apart nor flake off.

At Duchesne, the contractors (Grafe-Callahan Construction Co., and Rhoades Bros. & Shafner) used their own "home-made" variety of bolts—in two sizes, 5 and 6 feet, both 1 inch in diameter. They used "stopers" (pneumatic drills especially

THE WEDGE AND THE BOLT (1), a section of the Duchesne tunnel where roof bolts were installed (2), driving the roof bolt home (3, roof bolts in place (4), Bureau of Mines engineer Lester Naus of Salt Lake City, Utah, smiles as he proves you can't pull out one of these roof bolts, even with a 50-ton jack (5).

made for drilling upward—either straight up or diagonally) to drill $1\frac{1}{2}$-inch holes, exactly deep enough to accommodate the bolt to be used. With an acetylene torch they made a 6-inch slit in the butt-end of the bolt, inserted a steel wedge, and used the stopers to drive the bolt and wedge into the hole. As the wedge reached the end of the hole, the slit end of the bolt dovetailed, expanding against the side of the hole and anchoring it so firmly that even a 50-ton pull-out test cannot dislodge it. They then pinned the rock strata together by slipping a square steel washer and a bolt nut to the exposed portion of the roof bolt, thus preventing any spalling or slabbing. The holes were drilled as nearly as possible at right angles to the natural planes of weakness in the rocks.

Those who read the article entitled, "Difficulties at Duchesne" on page 88 of the May issue, will recall the "popping rock" and hard quartzite which has put Duchesne tunnel in a class by itself in the tough construction category. After breaking the usual number of drill bits holing through a certain section, the contractor learned that for 200 feet, the surrounding section was safe enough to leave unsupported. However, it was through quartzite, which can "pop" and might slab off, if no supports at all were used.

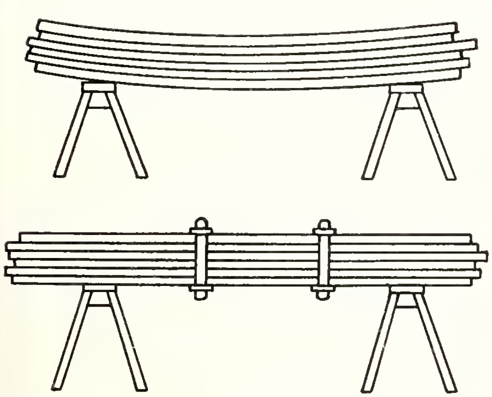
At this point, and rather than go to the expense of enlarging the tunnel in that section to place conventional steel supports, the Duchesne engineers decided to use roof bolts. This practice is not new, having been first tried systematically about 20 years ago in a lead mine, and is now quite a common practice in coal mines. The Bureau of Mines has worked closely in connection with their use and has conducted tests on the bolts used in the Duchesne tunnel.

Duchesne is the second Bureau of Reclamation tunnel which has supported itself by roof bolts. When the contractor for the Keyhole Dam diversion tunnel of the Missouri River Basin project in Wyoming could not get steel supports when he needed them, he asked the Bureau if he could use roof bolts to avoid delays. The method proved very satisfactory in this particular case, as the sandstone rock was similar in character to that encountered in coal mines. Success at Keyhole encouraged the use of this type of construction in tunnels excavated through other types of rock.

In the Duchesne tunnel, where laminated hard rock is predominant, tests made in cooperation with the Bureau of Mines indicated that larger size holes were more suitable for bores through harder types of rock. While the roof bolt method of support, with certain limitations, is practical and economical in hard rock tunnelling, conventional steel supports will still be required in the majority of cases. This demonstration, however, has encouraged the use of roof bolts for all future Bureau of Reclamation tunnels, the latest being the Frenchman Hills tunnel of the Columbia Basin project in the State of Washington, the Eklutna tunnel in Alaska, and tunnels on the Horsetooth and North Poudre supply canals of the Colorado-Big Thompson project in Colorado.

For estimate purposes, the Bureau usually allows for 10 percent of the tunnel to be supported by roof bolts and 25 to 75 percent by conventional steel supports, depending, of course, upon the character of the rock. THE END.

LIKE THE LUMBER, when it is tied together with bolts, holds itself in a rigid position, tunnel roofs are also held up by roof bolts. Arched tunnels, like the Duchesne, can take advantage of the same principle. ***Drawing by the Bureau of Reclamation's Graphics Section, Washington, D. C.***



SHORT CUTS TO WEED KILLING CALCULATIONS

PART 4—HOW TO CALIBRATE YOUR SPRAY RIG

Suppose you are an irrigation district superintendent faced with a problem of keeping operation and maintenance costs down, using the latest weed-control techniques. You have carefully selected the chemical needed, you have decided on the best time to do the spraying, and you know the best results with a particular chemical are obtained when applied at a given rate in pounds per acre. Now how do you get the amount of chemical on the weeds—no more and no less? Just follow these steps.

1. Knowing your ditch bank and the spray equipment, decide on a convenient operating speed for the rig. For average conditions on the ditch bank, the speed of about 4 miles per hour is satisfactory. Mark the throttle for the desired speed. This is MPH (miles per hour) on the Nomogram.

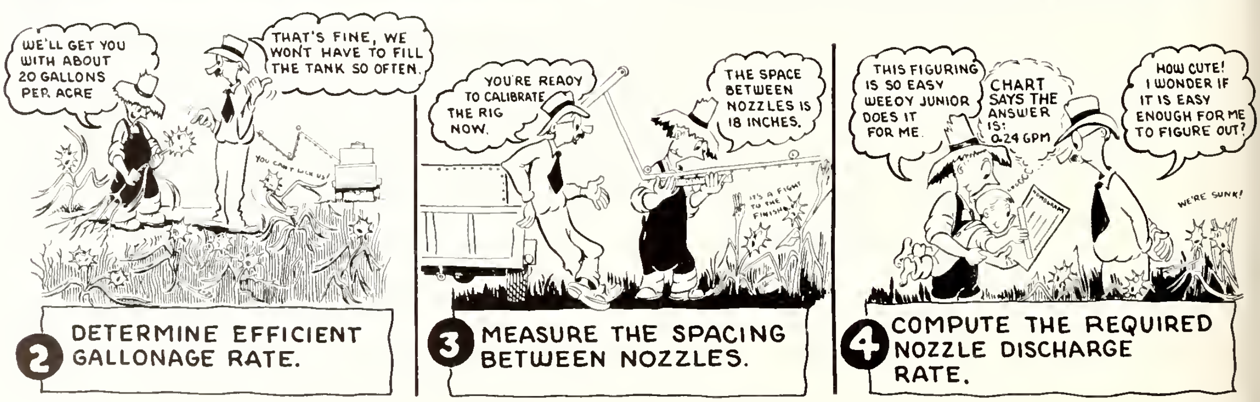
2. Consider the height of weeds, size of the spray tank, and type of spray solution, and decide upon the best amount of spray solution that should be put on per acre. This is the gallonage rate or gallons per acre you want to apply. On the Nomogram this value appears on the GPA (gallons per acre) scale.

3. Measure the distance between nozzles on the rig. This is the nozzle spacing in inches or feet. On the Nomogram inches appear on the NSI (nozzle spacing in inches) scale and feet on the NSF (nozzle spacing in feet) scale.

4. Using the Nomogram, determine the gallons per minute that each nozzle should put out to apply the solution at your gallonage rate and sprayer speed. This value appears as GPM (gallons per minute) on the Nomogram. The GPH (gallons per hour) scale is on the graph for convenience. It gives the gallons per hour delivered by each nozzle because sometimes it is more convenient to use GPH instead of GPM.

5. Fill the tank with about 10 gallons of the spray solution to be used. You should use the same spray solution for the calibration as for the actual spray job because different types of solutions come out of the nozzles at different rates under the same operating pressure.

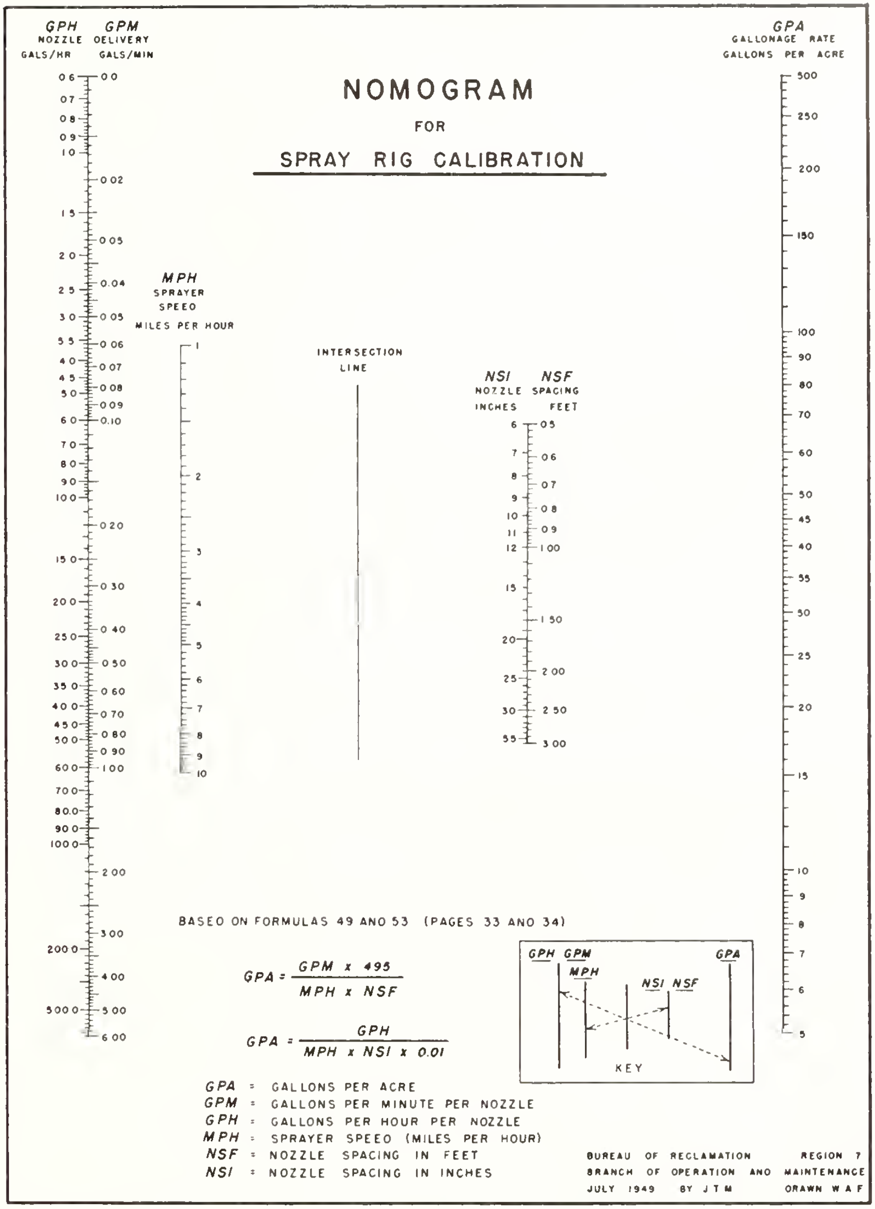
6. Adjust the operating pressure on the rig to a value that will approximately give the desired



by JOHN T. MALETIC,

Soil Scientist and Weed Specialist,

Region 7 Headquarters, Denver, Colo.



delivery in gallons per minute from each nozzle. This can be done by referring to the rating charts or graphs put out by nozzle manufacturers. These charts show the delivery from nozzles having various orifice sizes under different operating pressures. If these charts are not available, set the pressure at a convenient operating range.

7. Operate the rig and catch the discharge from one nozzle during a 2-minute period. Use a convenient container for catching the discharge so that you can easily measure the amount caught and convert it to gallons per minute. If the measured discharge rate from the nozzle is the same as that desired, the rig is calibrated. If greater or less than the desired amount is discharged with the initial pressure setting, increase or decrease the pressure as required and repeat the nozzle discharge measurement until you get the desired rate. (It is a good idea to check the discharge from several different nozzles. All nozzles of the same make and size should give approximately the same delivery.)

The calibration procedure described above is the best to use for most conditions. Another method sometimes employed may be briefly described as follows: Obtain the nozzle discharge at a convenient operating pressure measuring the delivery as described above; choose a desirable sprayer speed; measure the distance between nozzles; then use the Nomogram to get the gallonage rate. If this gallonage rate is satisfactory for the sprayer problem involved, the rig is calibrated and ready to go.

Having calibrated the rig, you still have another step involving preparation of the spray solution before you can put on the right amount of chemical per acre. That is, the calibration assures that you will be putting on a definite amount of spray solution per acre; now then, you must also make sure that each gallon of spray solution contains just the right amount of chemical. The next article in this series will carry a simple Nomogram to help calculate the amount of chemical to put in the spray tank.

Vaud Larson Heads Region 3 Project Planning Staff

Vaud E. Larson, key Bureau of Reclamation engineer in Lower Colorado River Basin investigations the past 5 years, with 20 years of unbroken service with the Bureau, has been appointed head of the Bureau's Region 3 Branch of Project Planning, succeeding E. G. Nielsen, who moved up from the regional planning engineer's position last December to be Regional Director E. A. Moritz' assistant. Mr. Larson has been in charge of the Phoenix, Ariz., investigations office since December 1944, with the title of assistant regional planning engineer. •

Brown Dies in Nicaragua

We regret to announce the death of Boyd Scott Brown of Denver, Colo., Bureau of Reclamation civil engineer, who flew from Washington to Nicaragua with a Point Four Reclamation Bureau mission on May 26, and died in Managua of a heart attack on Friday, June 8, 1951.

Mr. Brown was born in Denver, Colo., July 22, 1912, and was a graduate of the University of Colorado with a B. S. in civil engineering. Before he joined the Bureau of Reclamation in 1939 he had served as surveyor with the United States General Land Office in Denver, had spent 2 years as a junior engineer in Chile, and had worked for the Mead & Mount Construction Co., of Denver and Dunlap & Brummett, Ltd., San Gabriel, Calif. He is survived by his wife and two children who reside at the family home, 3069 South Ogden Street, Englewood, Colo. •

Columbia River's Armor Takes Shape

The first chapter in armor plating the Columbia River below Grand Coulee Dam has been completed and the second chapter is about ready to begin. (See "Armor Plating the Columbia", p. 198, October 1950 Reclamation Era.)

The Morrison-Knudsen Co., Inc., Seattle, finished placing more than 1,000,000 tons of armor and riprap rock, mostly for the river banks downstream from the dam, in April. The contract, which was for $1,810,429.74, was started on December 7, 1949.

More than half of the tonnage in granite rock, which was taken from the granite-wall quarry nearby and downstream from the dam, was transported by cable ferry across the Columbia River. The total tonnage was 511,000 tons.

The rest of the job for protecting the riverbank involves placing approximately 160,000 tons of armor rock and approximately 25,000 tons of riprap, mostly under water in the channel areas downstream from the dam.

The protection program is designed to protect the banks from the millions of horsepower in energy from the "unused" water which pours over Grand Coulee Dam spillway, in a 350-foot drop, during the summer run-off season.

The bid award for the new chapter of placing the under-water rock was made on June 29, 1951. Almost all of the work must be done in the low-water season. Only then does the Columbia flow quietly enough to permit the necessary barges and other equipment to work under the shadow of the dam. •

Reclamation Adviser to Remain in Ceylon

Paul von der Lippe, Bureau of Reclamation engineer on loan to the Government of Ceylon since October 1948, the first year the Ceylonese Government began to look to the United States for technical assistance with its development needs, will remain in Ceylon another year.

Under a new set-up, described as an "umbrella" type program for many kinds of projects, Mr. von der Lippe will continue his work of analyzing and recommending solutions for a wide variety of problems. These include technical, economic, administrative, and policy matters. Among them are the problems concerned with development of Ceylon's water resources and related economic and industrial developments in the over-all program of Dominion improvement.

A major program on which he is giving expert engineering advice is planning for rehabilitating or rebuilding extensive ancient irrigation works. Another is advising on the $15,000,000 Gal Oya Dam and power plant, a Ceylonese Government project which is being built in the heart of the Ceylonese jungle, under contract by a United States firm. To carry out this assignment, Mr. von der Lippe has penetrated the heart of the Ceylonese jungle where American engineers and Ceylonese laborers smashed down the jungle with bulldozers, and used modern tractors to build 30 miles of road to the site, about 85 miles from the city of Colombo. When completed, the Gal

Oya project will impound water to irrigate approximately 100,000 acres, adding 5,000,000 bushels of rice yearly to the world crop, and furnish 10,000 kilowatts capable of providing energy for big development in the sugarcane industry.

In addition to his advisory work on current projects and problems, Mr. von der Lippe serves as engineering consultant to the Ceylon Development Planning Board. This board formulates long-range policies and plans for irrigation and power production, road and bridge location, routing of transportation lines to load centers, land reform, industrial improvements, and related financial and administrative matters.

Mr. von der Lippe, born in Oslo, Norway, is a naturalized American citizen. He holds a bachelor of science degree in civil engineering from the University of Technology, Trondheim, Norway. He has been with the Bureau of Reclamation, Department of the Interior, since 1935, specializing in canal, dam, and power plant structural design, except for a brief period in 1943, when he was furloughed for war work. •

ALL ROADS LEAD TO GRAND COULEE—and the Bureau is building a four-lane highway between Grand Coulee and the top of Grand Coulee Dam. The 1.3-mile strip will use much of the existing road bed. Contractor for the paving job is Goodfellow Bros., Inc., Wenatchee, Wash.

Grand Coulee's Tenth Birthday

The tenth anniversary of the first power production at the Grand Coulee Dam was observed on March 22, 1951.

Where Grand Coulee kilowatts were a potential aid to defense 10 years ago, they are today a reality. In the past decade, Grand Coulee has become the greatest producer of hydroelectric power in the world. The total of 59 billion kilowatt-hours of hydroelectric energy which has been produced is equivalent in production to the energy generated by burning 29 million tons of coal or approximately 116 million barrels of oil.

Although it is the giant 108,000-kilowatt units which brought Grand Coulee its production fame, it was two of three small, 10,000-kilowatt-station-service units which were the first to start on March 22, 1941. These three small units, now in service, provide electricity for the dam installations and the Government town of Coulee Dam.

In addition, 17 of the 108,000-kilowatt units are in service. The sixteenth went on the line of the power pool early in April. The seventeenth followed in May and the eighteenth, and last, is to go on the line early this month.

When all 18 units of Grand Coulee are in operation, their combined electric output will be equivalent on a 3-shift basis to the work of about 85 million men—or about one-third greater than all the male workers of the United States.

The production of Grand Coulee in 1 year, without the final 3 units, represents enough energy to build 50 battleships.

Three 108,000-kilowatt units are enough to light all the dwellings in New York City and Chicago combined.

The current installed capacity of the plant is 1,866,000 kilowatts, although at peak operation (at which the units have been safely run for much of their history) the rating is 1,974,000 kilowatts. Bureau of Reclamation engineers estimate that one generator working for 1 day earns $5,000. •

First Reclamation Apprentice Graduates

Harvey W. Boyce, Boulder Canyon project electrician, became the first Reclamation apprentice to graduate in the Nation when he received his "diploma" on April 16 in a ceremony at Hoover Dam. At the same time, the project's Director of Power L. R. Douglass handed Boyce his promotion from apprentice to journeyman electrician.

Mr. Douglass said that the Boulder Canyon project scored two "firsts" with Boyce's graduation. He is also the first to start the training program of apprentices for journeyman status in the six basic crafts—carpenter, automotive mechanic, machinist, painter, plumber-pipe fitter, and electrician. A certificate for the apprenticeship course was issued to the project by the United States Department of Labor on August 1, 1949. •

WATER REPORT

The highest floods of record which occurred on the Kansas River and on the Missouri River from Kansas City to its junction with the Mississippi during July did not affect any existing Bureau of Reclamation projects. A flash flood on Cottonwood Creek, a tributary of the Niobrara River in northwestern Nebraska, during the latter part of the month, washed out the main canal of the Mirage Flats project, but it was anticipated that repairs, estimated to cost $15,000, would be effected and water deliveries resumed in time to avert any crop damages.

Irrigation water supplies as of August 1, 1951 continued to be plentiful over most of the West, but the extreme drought continued without relief in Arizona, New Mexico, and Texas. Only 90,000 acre-feet of water remained in the six reservoirs of the Salt River project, and less than 135,000 acre-feet was in storage in Elephant Butte and Caballo reservoirs of the Rio Grande project, setting another new record low. Water supplies are also short in the Pecos River Basin and in the San Joaquin Basin, in south-central California.

By regions (see map on back cover for locations) the situation is as follows:

Region 1—the outlook remains generally excellent. Hot, dry weather occurred over a major part of the northwest, but storage was ample in all cases to take care of the resulting heavy demand for irrigation water. Two pump units at Grand Coulee Dam were operated during most of the month, pumping a total of 143,000 acre-feet of water into the Grand Coulee Equalizing Reservoir.

Region 2—inflow into Shasta Lake during July was about 95 percent normal, while the inflow into Millerton Lake was 79 percent of normal. All projects will have sufficient irrigation water except for the Friant-Kern and Madera Canal service areas below Millerton Lake where the supply will be insufficient to meet all demands.

Region 3—storage in Lake Mead remained below normal, with flow into the reservoir during the month including the last of the snow runoff from the upper basin. Irrigation water supplies will be sufficient on all projects in the region, however, except on the Salt River project in Arizona where conditions remain critical.

Region 4—conditions are generally good. Rains in the headwaters of the Uncompahgre and Gunnison rivers improved the water situation for the Uncompahgre project materially. It is anticipated now that all projects will have sufficient water for maturing normal crops.

Region 5—water supplies are plentiful on the W. C. Austin and Tucumcari projects in the northern part of the region, but there has been no relief from drought in southern New Mexico and Texas. Upon demand of the Carlsbad Irrigation District, all water stored in Alamogordo Reservoir was released for project use. Storage in Elephant Butte and Caballo reservoirs of the Rio Grande project reached another new record low, and it is anticipated that the entire storage will be virtually depleted by the end of the irrigation season.

Regions 6 and 7—irrigation prospects are from good to excellent on all projects except the Belle Fourche in South Dakota where it is expected that the water supply will be barely sufficient for production of normal crops, with no carry-over storage in prospect in the Belle Fourche Reservoir. ●

LETTERS

Paging Lloyd Lewis

Our Denver office received the following letter, without a return address, or decipherable postmark. We have checked our subscription lists and cannot find the writer's name therein. Will he, or someone who knows him, please send his address to the Reclamation Era? We don't like to leave letters unanswered, but we have to know where to send them.

Dear Sir: I noticed in the Reclamation Era of June 1951 that a contract has been recently executed between the Government and the Kansas-Bostwick irrigation district which provides for the irrigation of 49,000 acres in northern Kansas.

As I am particularly interested in the possibilities of irrigation in our State, I am wondering if it would be possible to obtain a copy of the above mentioned contract.

If extra copies are available I would appreciate your mailing one to me.

Very truly yours,

Lloyd Lewis.

Purity Pays

Editor's Note: District Manager M. J. Miller, of the Lower Colorado River District, is still receiving a flood of letters as a result of the publication of "Yuma Homesteaders 'De-Bug' Water" in the December 1950 issue of the Era. Correspondence has also poured in to the Washington, D. C., office from people who are interested in this article on making ditch water safe to drink. The inquiries have come from people in Montana, North Dakota, South Dakota, New Mexico, Washington, California, Oklahoma, Idaho, Virginia, New Zealand, and Canada. Here are a few samples.

Arizona State Department of Health,
Phoenix, Ariz.

Dear Sir: Our attention has been drawn to an article appearing in the Reclamation Era for December 1950, in which a water purification unit developed by your office is described.

This office has received inquiries from health departments in other States as to the details and our approval of the unit. It would therefore be greatly appreciated if you would furnish this office with descriptive literature, detailed drawings, operating instructions, and/or other information issued to individuals interested in purchasing or building such a unit.

We would also appreciate receiving a summation of the methods and results of testing the performance and reliability of the unit.

Very truly yours,

George W. Marx,
C.E., M.P.H., Director and Chief Engineer, Bureau of Sanitation.

Washington Water Power Co.,
Coeur d'Alene, Idaho.

Dear Sir: The Kootenai County health department has brought to our attention the article written in the December issue of the Reclamation Era regarding the sterilization of water with germicidal lamps. This is new to me and I would appreciate any information you could send on such installations.

We have a definite need for such an application in our territory.

Very truly yours,

W. A. Lowry,
Washington Water Power Co., Coeur d'Alene, Idaho.

Ministry of Works,
Wellington, New Zealand.

Dear Sir: The article on page 242 of "The Reclamation Era" of December 1950, is most interesting and I would like to obtain copies of the diagrams mentioned in the last sentence of the article.

If you would kindly send me copies, this would be much appreciated.

Yours faithfully,

H. L. Hume,
Chief Designing Engineer, Ministry of Works, P. O. Box 24, Government Buildings, Wellington C. I., N. Z.

Falls Church, Va.

Dear Sir: Have read your very interesting article on the Yuma Mesa water-purification systems. A very ingenious idea. Could you possibly send me diagrams of the system. Particularly the germicidal lamp unit.

Would be grateful. Thanks.

Clyde Hurst, Jr.,
Mechanical Engineer.

Oklahoma Agricultural and Mechanical College,
Stillwater, Okla.

Dear Sir: Your article in the December issue of Reclamation Era entitled Yuma Homesteaders De-Bug Water is very enlightening. Many of our Oklahoma farmers have a pond as their only available source of adequate supply.

We are particularly interested in knowing more about the details in constructing the cylinder casing with lamp unit inside. Have you attempted to add any automatic shutoff device in case the lamp burns out?

We would appreciate any information that you or your engineer, Mr. Collopy, could supply us. We anticipate installing several test sets in the near future.

Yours very truly,

Elmer R. Daniel,
Assistant Professor.

(Mr. Collopy informed Professor Daniel that a relay and solenoid operated valve could be installed so as to cut off the supply of water if the lamp failed to operate. The characteristics of the relay could be such as to serve as a ballast and would not require extra current.—Ed.)

Canada's Department of Agriculture,
Regina, Saskatchewan.

Dear Sir: In the December 1950 issue of the Reclamation Era I read with great interest the article about the new compact water-treatment unit in use on the Yuma Mesa Division of the Gila project. I note that at the end of the article there is a statement that states "Diagrams of the system may be obtained by writing the District Manager, Bureau of Reclamation, Yuma, Ariz."

I would appreciate it very much if we could obtain from you the plans of this system as we have a very similar problem here at Outlook, Saskatchewan, on the Predevelopment Farm for the proposed South Saskatchewan River project, now under investigation by the Prairie Farm Rehabilitation Administration, Dominion Department of Agriculture.

Yours very truly,

D. W. Kirk,
Agricultural Scientist.

(All of the above correspondents and others whose letters we were not able to print due to lack of space received diagrams and answers to their queries. Mr. Collopy was frequently asked about the slim type of germicidal lamp. He states that if the slim type of lamp is selected, a smaller pipe of approximately 4 inches in diameter or a little larger could be used. The electrical characteristics of this germicidal lamp and its dimensions are the same as the ordinary fluorescent lamp and the same type of ballast and starter can be used.—Ed.)

Hungry Horse Gets an "A"

4513 Brandywine,
Washington 16, D. C.

Dear Mrs. Sadler: Thank you very much for sending me copies of the Reclamation Era. I made "A" on my Montana notebook and also "A" on my clay model of the "Hungry Horse Dam."

Your magazine added a great deal to my project.

Very truly yours,

Stephen Van Dyke Baer.

(This is just one of the many services rendered by the Reclamation Era, and represents the multitude of requests for information by students in the U. S. A. and abroad which are answered by our publication.—Ed.)

RELEASES

Reclamation Wall Map Available

A new vari-colored wall map showing existing and proposed Reclamation water resource developments in the 17 western States and Alaska is now on sale at the Superintendent of Documents, Government Printing Office, Washington 25, D. C. The price is $1 per copy.

Features of the new Bureau map graphically "spot" the 96 dams which store almost almost 83 million acre-feet of storage water, 35 power plants with over 3 million kilowatts of installed capacity, more than 16,000 miles of canals and 3,000 miles of transmission lines—all a part of the Reclamation program.

In addition to outlining Reclamation boundaries, regions, and headquarters, it also contains an inset key map showing the location of the 13 western river basin areas—the Missouri, Arkansas, Red, Gulf, Rio Grande, Colorado, Bonneville, Columbia, Lahontan, Southern Pacific, Central Valley, Central Pacific, and Northern Pacific. ●

Geographer's Study of Columbia River Basin

In the April 1951 issue of the Geographical Review, published by the American Geographical Society of New York, is an interesting and scholarly discussion of the Columbia River Basin under the title, "Rivers as Regional Bonds: The Columbia-Snake Example," by Edward L. Ullman, associate professor of regional planning, Harvard University. Dr. Ullman describes the Columbia-Snake River System, its transportation and population, new developments in irrigation, and the effect of new developments on the area-connecting role of the four main sections of the Columbia and Snake Rivers, which he terms "dioric" referring to streams crossing mountains, and "exotic" pertaining to rivers crossing deserts. Accompanying the study are photographs of the Columbia gorge, sagebrush lands, irrigated land, storage and power dams, and the Snake River Canyon, plus maps showing the Columbia and Snake Rivers in relation to mountains and deserts, the density of railroad passenger traffic, the density of highway traffic, the distribution of population, and present and proposed irrigated lands, the last-named map crediting the Bureau of Reclamation's map in "The Columbia River" as a source. All but one of the photographs were taken by Bureau of Reclamation photographers B. D. Glaha and F. B. Pomeroy. ●

NOTES FOR CONTRACTORS

Contracts Awarded During July 1951

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DS-3362	Davis Dam, Ariz.-Nev	July 17	Cordless telephone switchboard equipment for Phoenix dispatchers' office.	Kellogg Switchboard & Supply Co., Chicago, Ill.	$14,694
DS-3379	Colo.-Big Thompson, Colo	do	1 complete package-type switchyard, including power and distribution transformers, air switches, disconnecting fuses, fuse cutouts, supporting steel structures, and miscellaneous materials, for Willow Creek switchyard.	Industrial Electric Products, Inc., Phoenix, Ariz.	70,861
DS-3384	Davis Dam, Ariz.-Nev	July 27	1 switchgear assembly and one 13.8-kilovolt circuit breaker removable element for Davis powerplant, schedule 1.	Westinghouse Electric Corp., Denver, Colo.	17,350
DC-3390	Central Valley, Calif	July 20	Construction of Trauger pumping plant and high level distribution reservoir, Lindsay-Strathmore irrigation district, Friant-Kern Canal distribution system.	Stolte, Inc., and Fred J. Early, Jr., Co., Inc., Oakland, Calif.	709,603
DC-3394	Colo.-Big Thompson, Colo	July 16	Construction of Willow Creek pumping plant and Willow Creek pump canal with monolithic-concrete pipe for siphons and pump discharge line, schedules 1 and 3.	Peter Kiewit Sons' Co., Denver, Colo.	1,287,885
DC-3398	Central Valley, Calif	July 20	Construction of earthwork, pipelines, and structures for laterals 66.9W, 68.9W, and 69.8W and sublaterals, Ivanhoe irrigation district, Friant-Kern Canal distribution system.	United Concrete Pipe Corp., Baldwin Park, Calif.	636,277
DC-3414	do	July 16	Furnishing and installing additional distribution mains for Lindsay-Strathmore irrigation district, Friant-Kern Canal distribution system.	R. A. Wattson Co., North Hollywood, Calif.	624,227
DC-3415	do	July 20	Construction of earthwork, pipelines, and structures, including reservoirs and pumping plants, for laterals 74.6E and 77.3E, Unit 1, Exeter irrigation district, Friant-Kern Canal distribution system.	American Pipe & Construction Co., Los Angeles, Calif.	860,941
DS-3426	do	July 17	10 vertical-shaft turbine-type pumping units for pumping plants E1 and E2, laterals 74.6E and 77.3E, Unit 1, Exeter irrigation district, Friant-Kern Canal distribution system, schedule 1.	Food Machinery & Chemical Corp., Los Angeles, Calif.	27,014
DC-3430	Missouri River Basin, Wyo	July 23	Completion of Boysen Dam, power plant, and switchyard	Flora Construction Corp. and Flora Engineering Co., Denver, Colo.	413,378
DS-3440	Fort Peck, Mont	July 10	Four 115,000-volt circuit breakers, one 15,000-volt disconnecting fuse, and 3 potential transformers for Dawson and Williston substations, schedules 2, 3, 6, and 7.	General Electric Co., Denver, Colo.	110,489
DC-3444	Columbia Basin, Wash	July 23	Construction of earthwork and structures for West canal and Frenchman Hills wasteway.	Peter Kiewit Sons' Co., Seattle, Wash.	433,064
DS-3447	Central Valley, Calif	July 27	2 main control board extensions for two 69-kilovolt and four 115-kilovolt lines, and two 115-kilovolt and one 69-kilovolt transfer power circuit breaker circuits for Tracy switchyard.	Control Instrument & Engineering Co., Inc., El Paso, Tex.	30,500
DC-3456	Missouri River Basin, Wyo	July 23	Construction of earthwork, structures, track, and communications line for relocation of Chicago & North Western Ry., Boysen Reservoir.	Peter Kiewit Sons' Co., Sheridan, Wyo.	163,035
DS-3458	Columbia Basin, Wash	July 12	8 vertical-shaft turbine-type pumping units for Lake Lenore pumping plants Nos. 1 and 2.	Food Machinery & Chemical Corp., Los Angeles, Calif.	48,161
DS-3459	Cachuma, Calif	July 25	One 36-inch butterfly valve for Lauro Dam outlet works	Premier Gear and Machine Works, Inc., Portland, Oreg.	11,500
DC-3463	Eklutna, Alaska	do	Construction of 30 two-bedroom temporary residences and utilities for Palmer, Alaska, and Eklutna government camp.	C. William Hufeisen, Anchorage, Alaska.	343,000
DC-3467	Davis Dam, Ariz.-Nev	July 31	Completion of utility building and parking area at Davis Dam	Jack Willson, Downey, Calif	141,449
602C-8	Missouri River Basin, Wyo	July 9	Clearing part of Keyhole Reservoir site	Brasel Construction Co., Riverton, Wyo.	49,750

Construction and Supplies for Which Bids Will Be Requested By November 1951 [1]

Project	Description of work or material
Boise, Idaho	Generator voltage disconnecting switches and instrument transformers for Anderson Ranch power plant.
Buffalo Rapids, Mont	Construction of drains and related structures for area No. 2, First Division, near Glendive, Mont.
Cachuma, Calif	Construction of 12 miles of 36- to 27-inch concrete pipe conduit, part of the Carpinteria section of the South Coast conduit, near Santa Barbara, Calif.
Do	Construction of Tecolote tunnel control and chlorination house.
Do	Control piping, consisting of 36- to 46-inch diameter steel pipe, for Lauro distribution reservoir.
Central Valley, Calif	Erecting 2 prefabricated metal buildings at Orland and Elverta, Calif.
Do	Two 9,400-horsepower at 40-foot head, vertical-shaft hydraulic turbines for Nimbus power plant.
Do	Two 8,000/10,000-kilovolt-ampere autotransformers with three 115-kilovolt and three 69-kilovolt lightning arresters, and one 69,000-volt step voltage regulator for Folsom switchyard.
Do	Two 5,000/6,250-kilovolt-ampere transformers for Folsom power plant.
Central Valley, Calif	3 oil-pressure, actuator-type governors for 74,000-horsepower turbines for Folsom power plant.
Colorado-Big Thompson, Colo.	Construction of 9.4 miles of 115-kilovolt transmission line between Estes Park, Colo., and Pole Hill power plant.
Do	Main control boards, supervisory control and telemetering equipment, and 125-volt distribution boards for Pole Hill power plant and Flatiron power and pumping plant.
Do	One 13,800/480-volt unit substation, one 460-volt power distribution board, lighting transformer, and battery charging and control equipment for Flatiron power and pumping plant.
Columbia Basin, Wash	Construction of Lower Saddle Gap, Upper Saddle Gap, and PE 17 pumping plants and related laterals on Potholes East Canal.
Do	Modification of Pasco relift pumping plant near Pasco, Wash.
Do	Construction of Royal watermaster headquarters and temporary construction camp in West Canal area, about 7 miles north of Corfu, Wash.

[1] Subject to change.

Project	Description of work or material
lumbia Basin, Wash	Construction of 7 permanent, wood-frame, 2- and 3-bedroom houses with private garages and utilities, at operation and maintenance ditchrider sites in lateral areas E-3, P-1, and P-2 near Othello, Wash.
Do	Drilling four domestic water supply wells for operation and maintenance ditchrider sites in lateral areas P-1 and P-2 and three wells in lateral area E-3.
Do	Motor control equipment for Lower Scooteney pumping plant and Ringold pumping plant.
Do	One 1,000-kilovolt-ampere transformer for Ringold pumping plant.
Do	Drilling observation and drainage levels, placing perforated pipe, and installing hydrostatic pressure indicators for stabilization of Grand Coulee Dam right bank.
vis Dam, Ariz.-Nev	Constructing warehouse addition, area utilities, and street surfacing for system operation and maintenance area 3 miles west of Phoenix, Ariz.
t Peck, Mont	Conversion of existing Glendive pumping plant substation from 57- to 115-kilovolt operation and construction of 2 miles of 115-kilovolt tap line.
Do	Construction of prefabricated metal or concrete block warehouse and storage garage at Dawson substation near Glendive, Mont.
ndrick, Wyo	Construction of 12 two-bedroom wood-frame houses each with full basement and attached garage at Alcova Dam, about 32 miles southwest of Casper, Wyo.
Do	Construction of 1 mile of streets and construction of sidewalks, and sewage and water systems near Alcova Dam.
Do	2 oil-pressure, actuator-type governors for 26,500-horsepower turbines for Alcova power plant.
wiston Orchards, daho.	Construction of 30- by 80-foot warehouse near Lewiston, Idaho.
ddle Rio Grande, . Mex.	Construction of 17 miles of Rio Grande River drainage and conveyance channel and levee from San Marcial, N. Mex., to channel headworks.
nidoka, Idaho	Three 15- by 17-foot fixed-wheel penstock gates for American Falls power plant.
ssouri River Basin, Iont.	Clearing section of Canyon Ferry Reservoir above Winston bridge.
Do	1 set of rails about 80 feet long for 70-ton gantry crane for Canyon Ferry Dam.
Do	1 main control board, one annunciator relay cabinet, one 1,500-kilovolt-ampere unit substation, one 460-volt and one 25-volt distribution boards, and battery chargers for Canyon Ferry power plant.
Missouri River Basin, Nebr.	Construction of 9.6 miles of 210- to 125-cubic feet per second capacity, unlined Cambridge Canal, 6.4 miles of drains, and 5 miles of channel changes; seeding 80 acres of canal banks; and construction of timber bridges, monolithic and precast-concrete pipe siphons, road crossings, and unreinforced concrete canal lining.
Missouri River Basin, N. Dak.	Construction of 1,500-kilovolt-ampere Custer Trail substation 8 miles southwest of Bismarck, N. Dak.
Do	Construction of 2,500-kilovolt-ampere DeVaul substation 11 miles southeast of Almont, N. Dak.
Do	Construction of 750-kilovolt-ampere Fort Clark substation for Fort Clark irrigation unit in central North Dakota.
Missouri River Basin, N. and S. Dak.	Fabricated galvanized structural steel for bolted steel towers for 115-kilovolt single-circuit transmission line approaches to Fort Randall Dam and Garrison Dam switchyards.
Missouri River Basin, S. Dak.	Construction of 5,000-kilovolt ampere Midland substation.
Do	Construction of 3,750-kilovolt ampere Philip substation.
Do	Construction of 2,000-kilovolt ampere Wicksville substation.
Do	Construction of 2,500-kilovolt ampere Wall Substation.
Do	Construction of metal or concrete block warehouses and storage garages at Armour, Sioux Falls, Watertown, and Philip substations.
Missouri River Basin, Wyo.	Construction of 50 miles of 115-kilovolt Lovell-Yellowtail transmission line.
Do	Supervisory control and telemetering equipment for controlling Lovell and Thermopolis substations from Boysen power plant.
Okanogan, Wash	Rehabilitation of Conconully Dam outlet tunnel and spillway crest and chute about 15 miles northwest of Okanogan, Wash.
Palisades, Idaho	Installation of vibration dampers on transmission line about 13 miles south to 56 miles southeast of Idaho Falls, Idaho.
Riverton, Wyo	Furnishing and applying asphalt lining on reaches of Wyoming canal, first division; 0.6 mile of Wyoming Canal, second division; and 15.5 miles of Wyoming Canal and 22 miles of laterals, third division.
Shoshone, Wyo	Construction of waterways for drains in the Heart Mountain division.

United States Department of the Interior

Oscar L. Chapman, Secretary

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Washington Office: United States Department of the Interior, Bureau of Reclamation, Washington 25, D. C.

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THE RECLAMATION AREA

The Reclamation ERA

October 1951

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BUREAU OF RECLAMATION OFFICES — Inside back cover

Ruth F. Sadler, *Editor*

Subscription rate $1.50 a year for persons residing in the United States and Canada; $2 a year for foreign subscriptions; special rate of $1 a year for members of water users' associations, and Bureau of Reclamation employees.

OUR FRONT COVER

King of the Crops

Often referred to as "King Cotton" the royal family is one of infinite variety. Our front cover photo by George O. Bonawit, Parker Dam Power Project photographer, shows a fine field of short staple cotton called X–44 near Coolidge, Ariz. This new type is said to yield approximately 2¼ bales per acre. Last year, farmers on Reclamation projects raised almost 112 million dollars worth of cotton—making this the most valuable single crop in terms of gross returns. Cotton of the Egyptian or upland type is raised in Arizona, New Mexico, and Texas, while California grows largely the Acala type. The yield of cotton was 1.4 bales of lint per acre, and over 5 tons of cottonseed per acre.

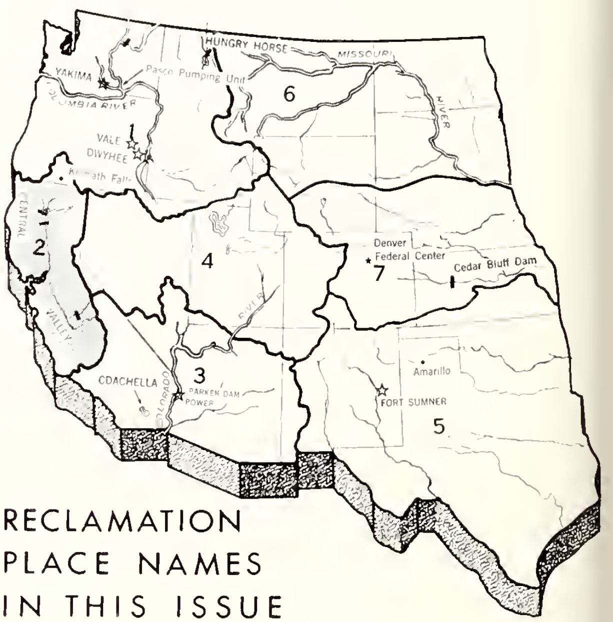
30 YEARS AGO IN THE ERA

We quote from a recent interview with Hon. Lucian W. Parrish, Representative from Texas, the following:

"With an ever-increasing population the time will soon come when America will find herself hard pressed to furnish homes and farms for her citizens and if we exercise the foresight of a far-seeing people we will make ample provision for sane and conservative irrigation and reclamation of nonproductive lands.

"Money spent in this manner is not wasted but is wisely invested and will bring to the Nation a manifold reward in the way of homes for its citizens and increased production."

(From p. 454 of the October 1921 issue of the Reclamation Record, predecessor of the Reclamation Era.)



RECLAMATION PLACE NAMES IN THIS ISSUE

America Needs All of Us

In cooperation with the President's Committee on National Employ the Physically Handicapped Week ("NEPH WEEK"—October 7–13, 1951), and in response to a request from the Chairman of the Committee, Vice Admiral Ross T McIntire (MC), USN, Retired, we present these typical examples of the part the Bureau of Reclamation is playing in offering opportunities to handicapped persons, on the farm, in the office, and on the construction job.

HUNGRY HORSE PROJECT

From the Hungry Horse project in Montana comes a heart-warming story of a tough, hard-boiled construction outfit that is doing an outstanding job in employment of physically handicapped workers.

Hungry Horse is the fastest growing concrete dam in the world. Set up originally on a drumhead tight schedule, the job is being high-balled to get reservoir storage capacity and power generation at the earliest possible date to help supply the critical power requirements of Pacific Northwest defense plants.

And the job has all the dangers inherent in construction of the world's third highest and fourth largest concrete dam. Working on a giant construction job like Hungry Horse Dam, a man needs better-than-normal physical equipment—not less.

But General-Shea-Morrison, prime contractor for the Hungry Horse Dam and power plant, has a strong policy of employing physically handicapped men on jobs which they can handle. Mel Hord, assistant to Project Manager C. W. "Smoky" Wood, is quick to point out that the policy is the result—not of altruism—but of the knowledge that these men, when placed in the right spots, frequently do a better job than men with unimpaired physical faculties.

As you make the rounds of the job talking to men who have been crippled by war, polio, tuberculosis, accidents, you find the reasons. They are simple, compelling reasons that should make

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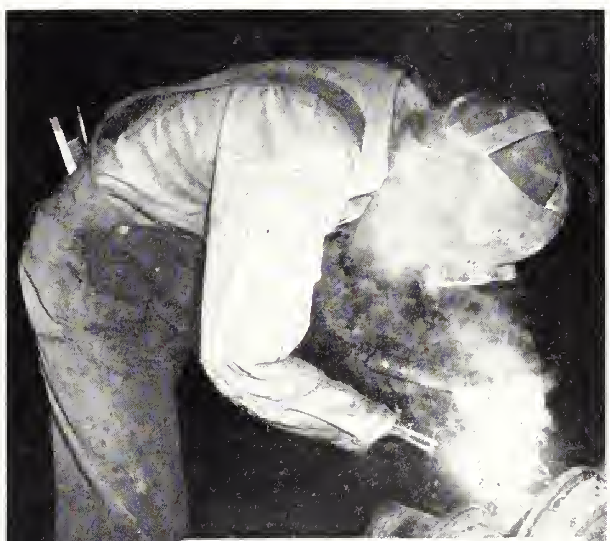

BALL-BEARING swivel gives flexibility of normal wrist to cableway operator Ralph Olson (above). Welder Art Stratton has to watch that hook (below). *Top photo by A. E. McCloud, bottom by James Clausen, both of Region 1.*

FLOOD TOWN—Aerial view of Ellis, Kans., after June 22 flood. Note channel of Big Creek in center of photo. Old-timers said this was the worst flood to hit the area in forty years. At top are Rudy Walter, left, and Pilot Dale Corder, beside the Kansas River District plane. *Photos by John N. Berg, Kansas River District photographer, Region 7.*

AIR-BORNE FLOOD WARNING

by N. Beth Woodin
Kansas River District, Indianola, Nebr.
Region 7 (Headquarters at Denver, Colo.)

R. J. (Rudy) Walter, Jr., Construction Engineer for the Cedar Bluff Dam, Ellis, Kans., recently enacted the role of Paul Revere—only instead of riding a horse ahead of the British Army, shouting "The British are coming!", Mr. Walter's "steed" was an airplane and his words were "The flood is coming!" And in contrast to Paul Revere's midnight ride, Rudy Walter's ride was made at midday.

It all happened at the time Ellis and Hays, Kans., were flooded on June 8, 1951. Big Creek, which flows through both towns, is usually a placid 80-mile long tributary of the Smoky Hill River. The flood of June 8 was the second time within a few weeks this creek had gone on a rampage. Previously about midnight on May 22, 1951, an unusual flash flood of about 20,000 cubic feet per second roared down the creek, hitting Hays, with its population of approximately 6,000, causing a property damage of over a million dollars and snuffing out 6 lives. This flood did not hit Ellis as it is some 13 miles above Hays, and the worst of this flood, caused by a record downpour of 11 inches in 30 minutes, occurred between the two towns and near the small town of Yocemento. During this downpour 2.34 inches fell at Ellis where Rudy Walter's office is located in the basement of Ellis city hall.

After the disastrous Hays flood in May, several rains fell in the area. It poured Wednesday night, June 6. The next morning the mayor of Ellis and other city officials told Mr. Walter that a report had come to them that Big Creek was running 2 miles wide below the town of Quinter, 40 miles upstream from Ellis. The mayor said that they had no regular flood warning system; they depended entirely upon word-of-mouth information to warn them of impending high water. It was impossible for the city officials to verify the rumor by telephone because the lines to the west were out as a result of the violent storm of the preceding night.

It happened that the Kansas River district plane was in Ellis at the time. The plane had come in that morning from the west over the upper reaches of the Saline River and the North and South Forks of the Solomon River, and Pilot Dale Corder reported that all of these streams were out of their banks. After instructing members of his staff to stand by for messages and to get the office records and other irreplaceable Government property ready for evacuation, Mr. Walter enlisted the aid of Pilot Corder, and taking a man from his office along to take aerial photographs, the three flew up Big Creek to its source.

They spotted the crest of the flood about 2 miles west of U. S. Highway 283 south of Wakeeney, Kans. The creek was out of its banks and was approximately one-half mile wide in places. Mr. Walter flew back to Ellis and confirmed the rumor. A flood *was* approaching, and this time it looked as if it would top the banks of Big Creek at both Ellis and Hays. Phoning the warning to Hays, he promised officials of both towns that he and his staff would get more definite news on the flood's severity and time of arrival, and would keep the city officials informed.

Through another lucky circumstance, when Mr. Walter went downstairs to his office, there was A. J. Ferrin, hydrologist with the United States Geological Survey, waiting to discuss some matters regarding gaging stations for Cedar Bluff Reservoir. In view of the emergency, they put a call through to the Survey office in Topeka, got an okay for Ferrin to postpone the scheduled business and help Walter. Ferrin drove over to Wakeeney Bridge to measure the stream flow. By that time Big Creek was flowing 3 feet over its banks. Ferrin rushed his instruments and readings to Walter's office where he and his staff figured out a "time table" for the flood, from Ferrin's stream measurement, their own knowledge of the area, observations made from the plane, and charts which measured river miles. According to their calculations the flood would reach Ellis at 4 a. m. early the next morning, Thursday, June 8, and by the time the flood reached Ellis, Big Creek would top its banks by 1 foot.

For on-the-spot checking, Mr. Walter stationed a man at the Riga Bridge between Wakeeney and Ellis to make periodic readings and reports to Walter's office.

(Please turn to page 224)

THE PEOPLE'S PIPELINE AT PASCO

by PAUL N. BICKFORD

Chief, Domestic Water Systems Unit, Columbia Basin Project, Wash., Region 1 (Headquarters at Boise, Idaho)

DOMESTIC WATER PROBLEMS may be a cinch some places—but not on many of our Reclamation projects. Even the practices of that ancient art of "water witching" meet with failure in the Columbia Basin project. Mostly the water is deep and often protected by several layers of extra-hard basalt.

The early settlers of Irrigation Block 1, living about 15 miles northwest of Pasco, Wash., have had their share of ups and downs in getting water into their homes. It is about 200 feet to water which means a cash outlay of close to $1,500 for a well and pressure system. A few had this kind of money but most of them needed every dime they possessed to build a shelter, buy farm equipment, seed, and some livestock. Essentials like domestic water had to go begging.

In the meantime the Bureau of Reclamation had drilled a well for the Pasco development farm and provided an outside hydrant for the convenience of water haulers. Out of this grew all types of conveyances from milk cans to surplus wing tanks mounted on trailers. Typical is figure 1, as Mrs. Scotty Getchell "pours." Such unhandy arrangements have been natural spurs to the desire of housewives to have a modern water system under pressure. Consequently the settlers started early to obtain such a system. An attempt was made to establish a local improvement district under the South Columbia Basin Irrigation District. This died an unhappy death because of changing personnel on farmsteads, rising costs, and opposition to the idea.

By the end of 1949 enough of the settlers were of one mind and a committee was formed for studying the situation. This original committee was under the leadership of E. D. Patterson, one of the settlers. He, with a lot of help from secretary Scotty Getchell, got 40 of the farmers to work together and form the Pasco Heights Domestic Water Association, incorporated under the State laws of Washington.

The Association applied to the Farmers Home Administration for a loan to construct a community water system. It was granted. The FHA engineers designed a water system for the 40 members, using the Bureau-owned well at the Pasco development farm as a source, it being leased for the purpose.

By late spring of 1950 it looked like water in the houses was assured, but before bids could be received, came Korea. Almost overnight, water pipe seemed to disappear. But largely through the tenacious determination of secretary Scotty Getchell, and with the help of some local newspaper publicity and the research of various chambers of commerce, enough pipe was discovered to do the job.

A contract was let late in the fall and despite various delays, by the middle of June this year water was delivered under pressure in all the homes of the association members. It has been good digging on the job. Figure 3 shows the rig that did most of it, and figure 4 shows pipe laid in the trench. In this case it was laid up to the main irrigation lateral, before auguring a hole underneath to make the crossing. It has taken quite a while, it is true, but it has been accomplished in the good old American style, by direct representation of the people. Figure 2 is a picture of the group, all settlers in the area, who kept plugging away until they got what they wanted.

A great deal has been learned from the experience of getting domestic water to the Pasco Heighters. It was found that it takes a lot of meetings to get people to think along the same

lines. It takes quite a bit of heavy money (about $1,350 per unit in this case), but through the FHA they get 30 years at 3 percent interest to pay out. It will take a tremendous amount of financing and planning to get water to the thousands of settlers who will pour into the Columbia Basin from 1952 on. It is a whale of a big undertaking; too large for one agency to handle. Realizing this the Bureau of Reclamation has entered into a co-

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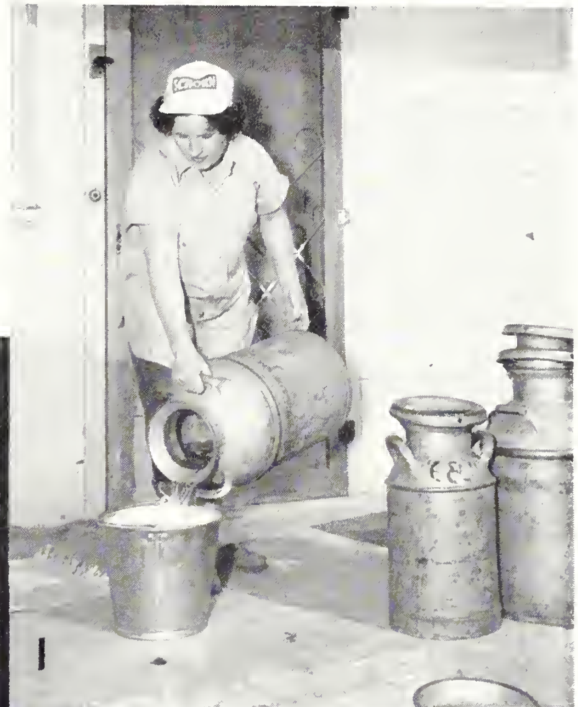
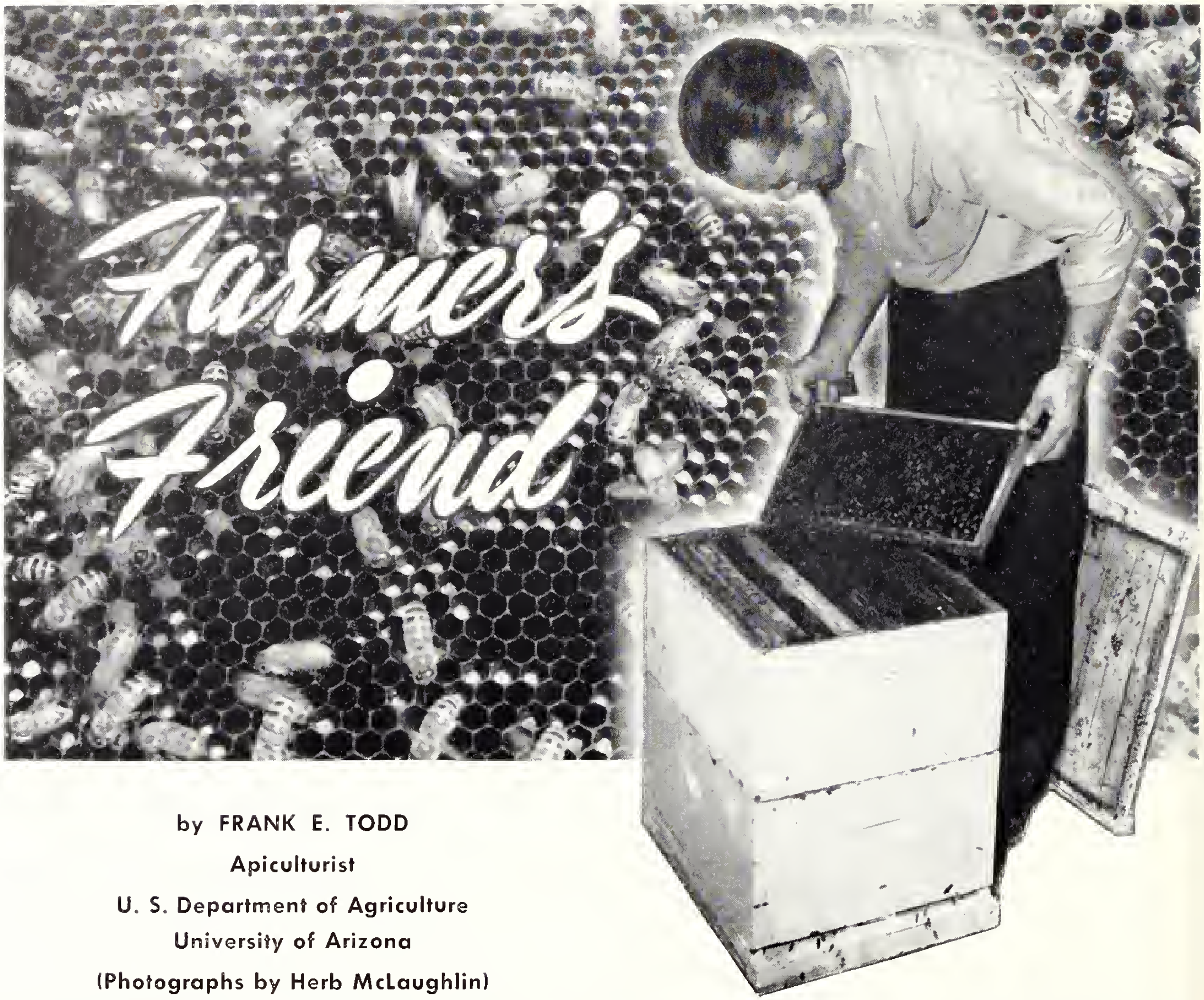


PITY THE PASCO HOUSEWIFE (1) before the domestic water system was inaugurated. This is how Mrs. Scotty Getchell and others "poured." (2) They were saved by the Pasco Heights Domestic Water Association Committee, left to right, Harry Bair, Ed Mosebar, Frank Shaw, Mrs. Getchell, Bill Lavercheck, Max Lord, and Scotty Getchell. (3) They dug ditches for the water system. (4) This is how the pipe was laid in the trenches. Robert O. Tschirky residence is in the background. ***Photo by Ellis Shorthill, Columbia River District photographer, Region 1.***



by FRANK E. TODD
Apiculturist
U. S. Department of Agriculture
University of Arizona
(Photographs by Herb McLaughlin)

ALTHOUGH THERE ARE NUMEROUS solitary bees native to Arizona, honey bees were brought by the white man. (The solitary bees build individual nests, do not live in colonies, and produce no honey at all and only enough nectar and pollen for their own use.—Ed.) The first honey bees, which the Indians called the "white man's flies," reached Arizona 234 years after their arrival in New England from Europe in 1638. Honey bees first reached San Francisco by boat from New York in 1853 and from the San Francisco-Sacramento area to San Diego in the early 60's. In 1872 Gen. J. B. Allen moved two swarms by wagon through the 500 miles of mountain and desert from San Diego, Calif. to Tucson. Thus did honey bees reach Arizona, and a new industry of ever growing importance was born.

The first two swarms to issue from General Allen's colonies were sold to L. C. Hughes of Tucson, who, during the next 2 years, increased them to 15 colonies. Many swarms from these were distributed during the early 80's to residents throughout the southeastern part of Arizona. (For these historical notes we are indebted to the Honorable Senator Carl Hayden.) According to the census, the industry had grown to 19,000 colonies at the turn of the century, and now, 50 years later, there are about 65,000 colonies in the State.

Many people are surprised to find an abundance of nectar-yielding flora in the desert. The early honey crops undoubtedly came largely from such native plants as mesquite, catclaw, and cacti, but cultivated plants were destined to grow in importance. Alfalfa was introduced into Arizona from California probably in the early 80's and its use spread rapidly in the agricultural valleys. Official records indicate that alfalfa contributed nearly half of the 1918 honey crop, and cotton

only 3 percent. The desert still supplies two-fifths, alfalfa one-third, and cotton one-fifth of the annual Arizona honey crop. Thus, during the past 30 years, cotton has become an important honey source. Arizona honeys are distinctive. Many people prefer the rich flavors of mesquite and catclaw honey, while others enjoy the spicy flavored alfalfa honey.

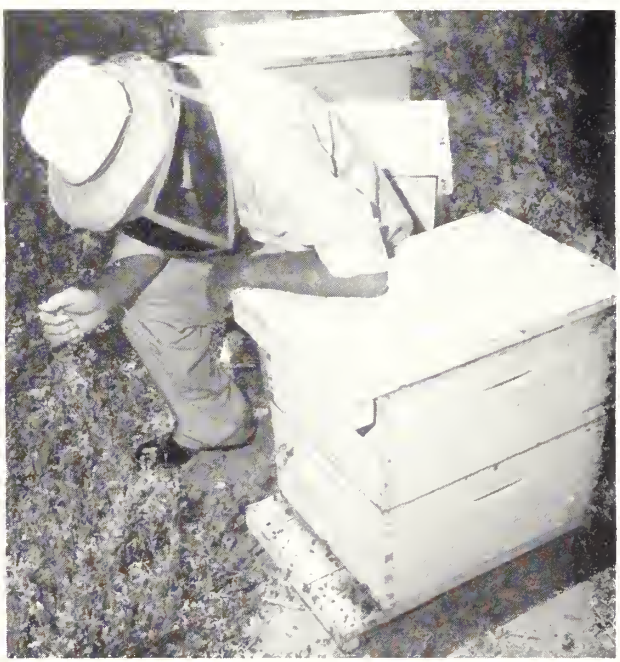
The development of bee culture has made a more important contribution to the State's resources than just the honey crop, for it provides pollination service for agricultural crops and ranges. The alfalfa seed, cantaloupe, watermelon, and vegetable seed industries are largely dependent upon bees for pollination. Cotton production is probably aided, although this needs further clarification. The value of the production of these agricultural crops far outweighs the half million dollar annual returns from honey and beeswax.

Flowering plants for the most part require an external agent to transfer pollen (the male element) to the stigma (the female part of the flower) before the ovule or egg can be fertilized and develop into seed and fruit. When plants such as alfalfa or melons are screened to prevent bee visits to their flowers—no seed or fruit is produced. If bees are introduced into such an experiment to serve as pollinating agents, the productivity of the same plants becomes so great it amazes the experimenter. The honey bee is a hairy creature and when it visits a flower to obtain nectar pollen, grains become entangled in these hairs. Flowers are so constructed that the visiting bee will rub some of the pollen on the stigma. On a food-collecting trip the bee visits only one species of plant and carries pollen from one plant to another, thus accomplishing the cross pollination necessary to maintain vigor in the offspring. The bee is interested in collecting food, but its visit to the flowers renders an indispensable service to plants.

The pollination of alfalfa has been intensively studied during and since the war because of an acute shortage of seed which could not be augmented by millions of dollars of subsidies or any other known means. An amazing discovery has recently been made which may revolutionize seed production methods. Scientists have, for many years, credited certain native bees with a major role in the pollination of alfalfa. Recent studies, however, have shown that in the principal seed producing areas of the West, honey bees are doing most of the pollination work for which native bees had been given the credit. The importance of this discovery lies in the fact that the seed grower need no longer leave pollination to chance, because honey bee colonies can be concentrated when and where they are desired. This cannot be done with native bees. By providing additional honey bee colonies, seed yields have been increased twofold and threefold over those obtained by the older method of leaving pollination to chance.

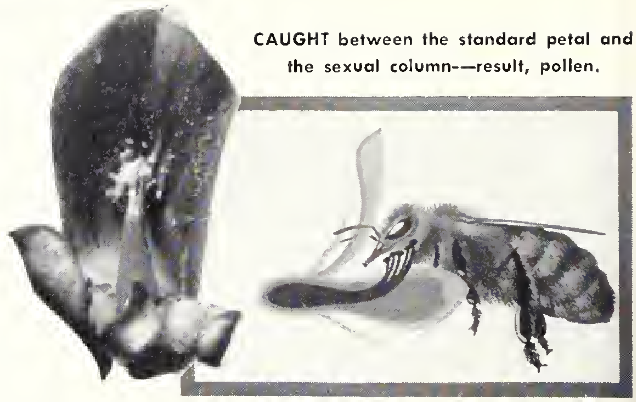
In newly cultivated areas of Arizona, alfalfa seed yields of 1,000 pounds or more per acre were

IMPORTANCE OF HONEY BEE IN SEED PRODUCTION is proved by expert studies and experiments, resulting in great benefits to farmers, beekeepers and merchants.



TRIPPING an alfalfa blossom. The bee inserts its head into the blossom.

CAUGHT between the standard petal and the sexual column—result, pollen.



obtained—but the cultivated acreage increased, and a greater demand arose for pollinators. The impact of agricultural development on native bees is severe, as their nesting sites in the soil are destroyed and insecticides kill the adults. On the other hand, honey bees are husbanded by man, and although they may be severely affected by insecticides, their numbers in the State have been maintained and increased more than fivefold during the past 50 years. This probably explains why native bees have declined in importance, while the honey bee industry has become an indispensable part of our agricultural economy.

Only a fifth of the 200,000 acres of alfalfa in Arizona is used for seed production. The seed acreage is definitely localized to Yuma County and in the Buckeye area of Maricopa County. These are the areas having the highest concentration of apiaries, but this coincidence has been overlooked until recently. In other parts of Arizona, seed yields have been unaccountably too low for profitable production, but the recognition of the honey bee as a pollinator may help to extend the seed-producing area.

The alfalfa flower is a classic example of a perfected floral structure designed to effectuate cross-pollination. It has an explosive pollinating mechanism which acts like a trap for bees. When the bee extends its proboscis into a flower, with its head pressed against the standard petal, a tripping mechanism is contacted which opens the keel and releases the sexual column. The tip of the sexual column bears the pollen-yielding stamens and a stigma. When released, this column springs forth explosively, striking forcefully the lower rear portion of the bee's head where it deposits a mass of pollen. The bee's head is pinched between the standard petal and sexual column, and when pulled free it still bears a pollen mass. Sometimes this "explosion" is so forceful that it actually can be heard and on rare occasions the bee is unable to extricate its head. Cross-pollination is accomplished by repeating this performance in the next flower visited, the stigma being embedded in the pollen mass from the previous flower until the bee frees its head. Until the flower is tripped, the sexual column is hidden within the keel, but, after tripping, it remains exposed to view, pressed firmly against the standard petal. Within a few hours the petal wraps around the sexual column and wilts, giving a field of rapidly tripped flowers a brownish cast. A field with few tripped flowers has a solid bluish-purple cast resembling a flower garden.

The pollen-gathering bee transfers pollen caught in its body hair to "baskets" on the outside of its hind legs. When a full load is collected, it is carried back to the hive where it is fed to young bees and eaten by nurse bees to be converted into royal jelly. Pollen supplies the colony with the protein, minerals, and vitamins necessary in the bee's diet, while nectar supplies the carbohydrates. To obtain a load of pollen, the bee visits about 350 flowers.

Some idea of the size of the task of pollinating Arizona's alfalfa seed crop may be gained by an estimate of the number of flowers involved. About 400 million flowers are borne by an acre of alfalfa grown for seed and these will not produce seed pods unless tripped and cross-pollinated. At this rate the average 38,000 acres devoted to seed in Arizona would provide 15 trillion flowers to be visited during a 4-weeks' flowering period by a field force of about 1.5 billion honey bees in the State. Of course, not all colonies are located in seed fields. It is not surprising that investigation indicates a deficient supply of pollinators, and that

(Please turn to page 229)

FIRST LINE OF DEFENSE against drought is the new diversion dam, above, recently completed by the Bureau of Reclamation for the Fort Sumner, N. Mex., irrigation project. At left, a section of the main canal, near the city of Fort Sumner.

FORT SUMNER FORTIFIED

FOR THE FIRST TIME in the 87-year-old irrigation development in the Pecos River Valley near Fort Sumner, N. Mex., farmers now have a dependable system for spreading Nature's capricious supply of water over their croplands. Construction of a new diversion dam and rehabilitation of the canal and drainage facilities have been completed by the Bureau of Reclamation (see article entitled, "Fortifying Fort Sumner" on page 74, April 1950 issue, for background material).

Without fanfare or any sort of ceremonies to mark completion of the building program, farmers have tapped the distribution canals to send water flowing over their cultivated lands and pastures. The Bureau of Reclamation's engineering staff, with the exception of a small force to direct cleanup work, has been transferred to other jobs in western river basins.

Abraham Lincoln was president of the United States when the first irrigation development came into existence at Fort Sumner, the settlement established in honor of E. V. Sumner, commander of the Ninth Military Department in New Mexico. The first irrigators there were Navajo Indians who abandoned the experiment in 1868.

Interest in an irrigation project in the area was revived in the early 1900's, a period of heavy westward migration. However, a lack of adequate engineering, coupled with floods, resulted in severe damage to the diversion works and water-distribution system. Subsequent attempts to place the project on a sustaining basis were marked with failure. In the late 1940's, property owners requested the Bureau of Reclamation to investigate the valley's problems, and design and construct a system to serve the 6,500-acre project. Irrigation district directors signed a contract with the Federal Government in 1949 to repay construction costs, and the Reclamation Bureau began its building program in 1950.

Work performed by the Bureau includes a new diversion dam, 150 feet downstream from the original structure, 3 miles northwest of Fort Sumner; enlargement of the canal system; installation of a pumping plant to deliver water to the project's high line canal; and rehabilitation and extension of the drainage system. The diversion dam is 50 feet high, with a crest length of 650 feet. Much of the main and high line canals is concrete lined.

A unique feature of the project is the pumping plant. The power required for raising water from the main canal to the high line canal is obtained without cost. The power is generated by dropping water 11 feet at one point in the system. Power created by this drop is used to pump the water to a height of 12 feet from the main canal into the high line canal.

Principal crops grown on the Fort Sumner irrigation project include alfalfa, corn, grain sorghums, vegetables, apples and grapes. THE END.

FOR THE GOOD OF THE LAND—The definition of "Bonifica"—under the E. R. P. (Economic Recovery Program) of the ECA, road-building goes on at the Destra Sele, or Right Sele reclamation project near Solerno. The rock base is 20–25 centimeters thick. Each man working on the irrigation canal for this project moves an average of 4 cubic meters of earth each day—see photo above.

Reclamation under the Marshall Plan in Italy

by W. E. CORFITZEN, Reclamation Specialist
Economic Cooperation Administration, Rome, Italy

PART 3

COSTS AND BENEFITS OF THE PROGRAM

EDITOR'S NOTE: In part 1—How the Program Began, and Part 2—the Working Plan, Mr. Corfitzen dealt with the background of the plan for rapidly improving the Italian national economy through reclamation development, including comparisons between the problems of the United States and Italy, and the manner in which the programs were developed. In this issue, he points out the cost of the projects and the benefits which the Italian people have received, or will receive, as a result of reclamation work in that country.

THE ANTIMALARIA PROGRAM is being carried out by the High Commissioner for Hygiene and Public Health with funds furnished by ECA through the Ministry of Agriculture and includes 115 districts in 28 provinces of Italy, involving approximately 1,400,000 people. While no land is directly improved through this program, there is no doubt that the indirect benefits, although difficult to assess, are extremely large. Since the summer of 1948, approximately $400,000 has been made available to carry on this work.

The War Damages program which has been approved by the Mission involves an expenditure of approximately $4,500,000 for the rehabilitation of farm roads, culverts, irrigation and drainage ditches, bridges, telephone lines, etc., destroyed or damaged on Italian reclamation projects by military action. Part of the damage was due to the wear and tear occasioned by military traffic while other damage was caused by explosion, some accidental and other intentional, as in the case of bridges destroyed by retreating troops. For this category there was a lump sum allocated to be used on 103 specific projects.

The Mountain Basin projects involved a proposed expenditure of approximately $7,000,000 during the first year of ECA assistance. Only a very small part of this problem was approved because after examination it appeared to Mission investigators that immediate benefits would not be commensurate with the proposed expenditures. Accordingly, after agreement with the Ministry of Agriculture, the unallocated balance tentatively allocated to the Mountain Basin program was transferred for use on the Acceleration and Concentration A categories. A total of 652,180,000 lire ($1,043,504) has been approved for 46 projects in this program.

Although 42.6 billion lire ($70,000,000) was al-

Italy: Estimated Benefits of ERP Counterpart Land Reclamation Program

[4-year program]

Item	Quantity			
	Metric units		English units	
Newly irrigated land	Hectares	409, 000	Acres	1, 100, 000
Irrigation canals	Kilometers	8, 950	Miles	5, 560
Irrigation water supply	Liters/sec	440, 500	Acre ft./day Cu. ft./sec	6, 250 12, 500
Reclaimed land	Hectares	335, 000	Acres	828, 000
Drainage canals	Kilometers	2, 880	Miles	1, 790
Pumping stations	Number	44	Number	44
Earth filling	Hectares	800	Acres	1, 980
Reforestation	Hectares	27, 000	Acres	66, 700
Land protected from flood	Hectares	164, 000	Acres	405, 500
River control	Kilometers	1, 570	Miles	975
Roads	Kilometers	4, 100	Miles	2, 550
Bridges	Number	480	Number	480
Farm buildings	Number	17, 000	Number	17, 000
Family group houses	Number	19, 000	Number	19, 000
Drinking water supply	Liters/sec	1, 200	Gals. daily Gals./min	27, 360, 000 19, 000
People supplied with drinking water	Number	410, 000	Number	410, 000
Electric power:				
Installed capacity	Kilowatts	30, 000	Kilowatts	30, 000
People supplied with electric power	Number	330, 000	Number	330, 000
Working days employed in the implementation of works	Number	70, 800, 000	Number	70, 800, 000
Working days per year employed in more intensive cultivation (permanently).	Number	30, 900, 000	Number	30, 900, 000

located for the reclamation program during the first year of ECA operation, the development of a program of acceptable projects took some time and Italian finance procedures made it impossible for the Ministry of Agriculture to allocate counterpart funds until enabling legislation was passed. Such legislation was enacted on April 23, 1949, and work was thereafter authorized on the projects theretofore approved by ECA.

The development of construction organizations on the various projects took some time and it became evident that the funds originally contemplated for expenditure during 1948–49 would be sufficient to carry on construction during 1949–50. Accordingly, no appropriation was made for the agricultural program in 1949–50.

During the past few months there has been created within the Government an organization known as "Cassa per il Mezzogiorno" (meaning "Fund for the South"), which has the responsibility of developing agriculture, expediting construction of all reclamation projects in Southern Italy, and also developing the tourist industry. The Parliament has also enacted a law known as the "Cassetta Law," which provides for expediting the development of depressed areas in North-Central and Northern Italy. Consequently, from now on the reclamation projects of ECA, formerly entirely within the Ministry of Agriculture, will be under the Ministry of Agriculture, the Cassa or Cassetta, depending upon the location of the proj-

PRECAST CANAL LINING BLOCKS are set in the irrigation canal on Brian project in the Veneto region of Northern Italy.

ects. The Counterpart Lira Fund is building up and funds will be made available to carry on construction of the Acceleration, Concentration A and Antimalaria projects as soon as the budget is worked out by these agencies for 1950–51 and 1951–52.

As of December 31, 1950, the reclamation projects had furnished 4,448,000 man-days of work. Time has not been available to assess exactly the benefits already achieved by the works undertaken, but some idea of the magnitude of the benefits anticipated may be seen in the table on page 223. Mission investigators are now examining certain new features which are being proposed on various projects already under construction and as these investigations are conducted, opportunity is taken to check on the amount of work already completed and the benefits achieved.

In a land of limited area, with an estimated population of 46,600,000 and with 2,000,000 men presently unemployed, the item of most interest to the Italian people is the fact that about 71,000,000 man-days of labor will be required to complete the works started with ECA funds and that upon completion lands will be developed to the extent that 120,000 men per year will be furnished work in the fields in addition to those already employed. To the trained agriculturist and economist, hope lies in the fact that over a million acres of land will be brought under irrigation while over 800,000 acres will be reclaimed from swamps to add to the internal food supply of Italy, which is so sorely required. THE END.

Air-borne Flood Warning

(Continued from page 215)

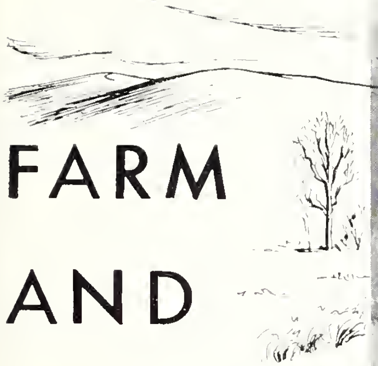
Mr. Walter and members of his staff stayed on duty all night and the next day, reporting the progress of the flood to city officials in Ellis and Hays and to Radio Station KAYS at Hays, which made hourly broadcasts throughout the night. The flood hit Ellis at 4:10 a. m., only 10 minutes later than the time estimated by Mr. Walter, and Big Creek topped its bank by 1 foot, exactly as estimated. Water ran through the streets of Ellis anywhere from knee to waist high. Hays was hit by the flood waters 12 hours later, at 4 p. m., June 8. Not until after the flood had passed Hays did Mr. Walter and his men leave the job.

Because of the adequate warning of the approach of the flood given the people of Ellis and Hays by Mr. Walter, property damage was held to a minimum and no lives were lost. The basements of 50 homes in Ellis were flooded and property damage was estimated at $5,000. Residents had ample time in which to remove their possessions from the basements and first floors of their homes, thus holding the amount of property damage to a minimum. Because residents of Hays had not completed the cleaning up of their homes after the May 22 flood and the same area was hit on June 8, no estimate of the property damage was made at Hays.

The people of Ellis and Hays were grateful to Mr. Walter. When Reclamation's Commissioner Michael W. Straus arrived in Ellis on June 10 to take part in the dedication ceremonies for the Cedar Bluff Dam, they told him what Mr. Walter had done. Commissioner Straus casually mentioned in his address at the dedication ceremonies that if the people of Ellis or Hays ever needed any expert flood forecasting done, they need only call on the Cedar Bluff field office of the Bureau of Reclamation.

As an interesting aftermath of this story, that is exactly what they have been doing since the Commissioner's visit. Severe rainstorms continued throughout June, and being fully conscious of the disaster a flood can cause, the townspeople have kept Rudy Walter and his staff busy investigating reported high water after every rainstorm of any proportion that has occurred since then. Flood conditions following heavy rains on June 10, June 21, and June 26 were checked by the Cedar Bluff field office. These rains caused no overflow at Ellis or Hays, but a flood of even greater severity than the May 22 Hays flood occurred on June 22–23 at both Ellis and Hays. (Big Creek is not one of the streams on which the Bureau is working, and only very sketchy records exist prior to the June 8 flood for comparison. However, old-timers say the June 22–23 flood was the worst in 40 years.—Ed.) This time, however, both towns were adequately warned. No lives were lost and the property damage was much less than in May, thanks to Rudy Walter and his staff. THE END.

FARM AND PHEASANT



Idaho's reclaimed areas provide sanctuary for wild birds and sport for hunters

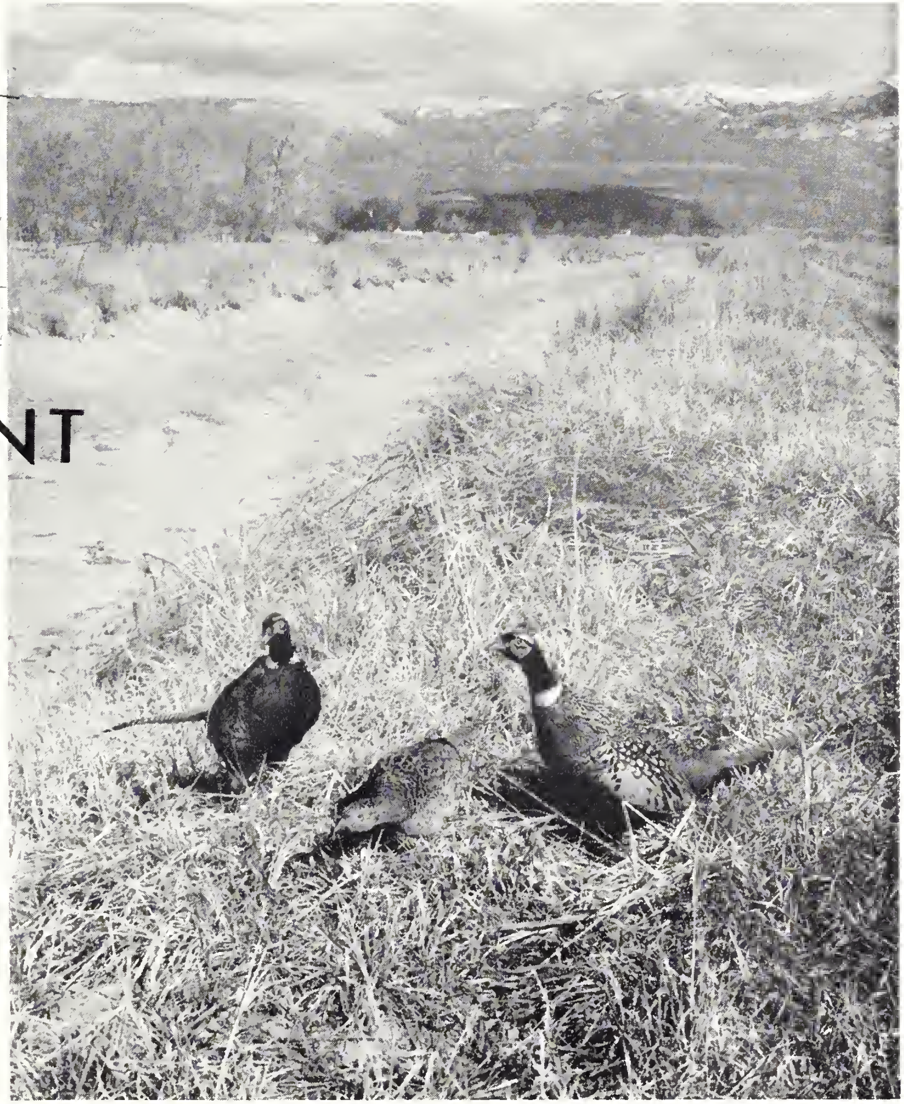


Photo by Stanley Rasmussen.

by O. M. BROWNE
Assistant Regional Planning Engineer, Region 1, Boise, Idaho

The pheasant, because of irrigation, is in Idaho to stay.

This regal bird has been in the State about 43 years and its presence is mutually satisfactory to man and bird—to the pheasant because of the food, water, and shelter provided throughout the extensive irrigation belt, and to Idaho people because the bird offers some of the finest hunting found anywhere.

A lion's share of the State's bird acreage lies in southern Idaho. There the Chinese pheasant and its close relatives, the Mutant and the Mongolian, inhabit tangled cover along ditchbanks, unused corners of irrigated fields, strips of border land between cultivated fields and sagebrush desert, and, of course, the fields of corn, beets, alfalfa, and other crops. Wherever there is something to eat, a supply of water within reasonable distance, and cover in which to take refuge when the fall artillery blasts start, Mister Pheasant is a prominent resident.

The Idaho Fish and Game Department figures there is about one bird to every three acres of irrigated habitat, where without irrigation there would be none, or hardly any. Some $2\frac{1}{2}$ million acres of land are irrigated in the State.

The Idaho figures are supported by data from nearby eastern Oregon projects. On the 32,000-acre Vale development, for instance, the Oregon Game Commission found, on the basis of a 4-year

study, an average of 38 pheasants per 100 acres. The same study found a similar proportion on the nearby 100,000-acre Owyhee development.

Idaho's hunting paradise is not necessarily duplicated wherever there is irrigation. Altitude is an important factor. If the zone is high, the winters long, and the springs generally wet and cold, the pheasant has hard sledding.

Although there is no way of telling down to the last bird precisely how many pheasants there are in Idaho, Maurice Lundy, bird supervisor for the Fish and Game Department, estimates the Idaho population at about 1,500,000 in an average year. Hunters get approximately one-third of the lot each season. The daily bag and possession limit is two roosters. In 1949, western Idaho, the cream of the hunting area, had a limit of three, plus a day or two of hen shooting in certain localities. Tightening of the limit is not so much an indication of fewer birds as it is an increase in hunters.

The best information the game department has been able to discover credits introduction of pheasants in Idaho to a barber named Ed Foster, who brought a few to the Twin Falls tract near his home town of Buhl in 1907. This was about the

HUNTER'S PARADISE, abo hee reservoir in Oregon, duck-hunting area createc eral reclamation construc left, the author, O. M. with his black Labrac "Mucho" who, besides a profitable pastime for hi has managed to take t in western field trials. right, Tex Everhart and E exhibit some of the pheas shot, proving that southe and eastern Oregon ar hunting grounds. *Photo b Rasmussen, Region 1 photo*

time Federal Reclamation was getting a foothold on the Minidoka project.

Chinese pheasants depend on civilization—a paradoxical situation. Civilization, as represented by an army of hunters, does its best to wipe out pheasants every fall. If it were not for man there would be a thumping big flock of birds. On the other hand, if it were not for the crops men raise—mostly on land that has been reclaimed from sagebrush—Idaho would be as bare of the species as it is of the kangaroo.

The pheasant is a semi-domestic customer. The chief feed is by-products of farming. Some farmers say that the pests don't confine themselves to by-products, by jimminy. They pick up a little corn seed, get into field crops, and once in a while their exploring beaks work over a watermelon patch. On the whole, however, the damage pheasants do is offset by their destruction of insects.

Ideal pheasant country, sportsmen say, is to be found on stretches of irrigated land adjoining unbroken stretches of raw desert. Birds come down to the canals and hay fields to nest. They raise their young in the proximity of good food supplies. Fence rows that are not skinned bare afford them cover in the fall when the shooting starts. Large numbers are also flushed from the coarse growth along reclamation canals that serve the dual purpose of hiding place and source of water.

The advantage of the nearby sagebrush, as far as the birds are concerned, is as a refuge. It is a habit of the sensible creature to vanish into the wilderness when the bombardment starts. He makes use of his wings to get into the brush, and then he runs around all day playing games with hunters and dogs. In the evening the pheasant drifts back to the crop land for rations, and a roll call of his remaining relatives.

Whether it is a coincidence or a rule that can be regarded as reliable, newly broken reclamation projects seem to provide better pheasant country than some of the old and established tracts. About 2 years after cropping is started, the birds take foothold. Perhaps they like to pioneer, or believe the human beings on the new project will be more friendly. At any rate, hunters who have combed a

lot of Idaho are commonly anxious to try their luck on a brand new project.

Take, for example, the Black Canyon tract on the Boise project, between Caldwell and New Plymouth. Fifteen years ago there wasn't a healthy magpie on the desert, let alone a game bird. Today the water has come, and with it farming and beneficial wildlife. Pheasant cover is good because there are many parcels of land only partially cultivated. On some slopes the vegetation is coarse. Annual weeds remain in jungled profusion. That may not be good for agriculture, but it is great medicine for Mr. Pheasant. As necessary improvements are made and his habitat is less advantageous, the bird will continue to find a happy home on an irrigated farm. Only he will spread himself a little thinner, as he has in the past, when row cropping and the improvements of smart agriculture have stepped close to his tail feathers.

Water has been important not only to pheasants but in the encouragement of quail and other game birds that are to be found on many Idaho tracts.

The suitable habitat provided by such artificial lakes as Lake Lowell on the Boise project (once called Deer Flat Reservoir) in Canyon County is credited by wildlife officials with a major part in influencing the flight of waterfowl. Millions of ducks and geese visit the lake every fall. The local duck population is increasing because more and more of the migrants find conditions to their liking in normal years. They go no farther south. Large numbers remain to nest along the rivers of western Idaho. The reservoir is an assembly and distribution point for a considerable portion of all the ducks in the area. Without it far more ducks would fly on south without pausing and hunting would not be up to the present level.

Yes, Federal Reclamation and wildlife conservation have purposes in common. THE END.

MILLIONS OF CANADA GEESE and other waterfowl use Lake Lowell (once called Deer Flat Reservoir), the Bureau of Reclamation reservoir on the Boise project in Idaho as a winter refuge. Some remain to nest. ***Photo by Bus Howdyshell, Pendleton, Oregon.***

Peoples Pipeline at Pasco

(Continued from page 217)

operative agreement with the Agricultural Extension Service of the State College of Washington at Pullman, and the Farmers Home Administration whereby technical studies are made of all irrigation blocks and detailed estimates of costs determined. Consequently, when the potential settler seeks information about domestic water his questions will be answered by a well-studied plan that will point the way to orderly development of domestic water facilities. THE END.

FARMER'S FRIEND

(Continued from page 220)

it is necessary to increase the number of colonies attending alfalfa fields from one per acre, which is profitable for honey production, to five or six to obtain seed yields of a thousand pounds or more per acre.

The construction of the alfalfa flower permits the collection of nectar without tripping. The bee inserts its proboscis between the overlapping wing and standard petals, avoiding the tripping mechanism and the forceful punch in the head that accompanies tripping. Individually, nectar gathering bees trip fewer flowers than pollen gatherers, the number depending on the condition of the plant. However, nectar gatherers usually outnumber pollen gathers in the field and because of their greater numbers may contribute nearly as much tripping. Placing colonies in or adjacent to the alfalfa field may result in more tripping. Possibly the younger bees range less widely from the hive, or they trip more blossoms while "learning" to obtain nectar without tripping.

Of course, many factors enter into the setting of a good seed crop. Providing a heavy concentration of bees will not in itself insure a seed set. Proper attention must be given to the agronomic factors and the harmful insects must be controlled. Disregarding any of the essential factors may result in a seed crop failure.

A problem which calls for unusual skill and ingenuity on the part of entomologists is how to control the harmful insects on alfalfa without also destroying the pollinators. The most harmful insects to seed production are the lygus bugs which feed on the developing buds and flowers, preventing adequate flowering and doing other damage. It is a tribute to entomological skill that methods have been worked out whereby these insects can be controlled with a minimum of destruction to the pollinators.

Arizona has some features which are unique in beekeeping. The intense summer sun makes it necessary to provide shade over apiaries. These shades are called ramadas and may be seen about the valleys. It is surprisingly cool in the shade of the ramada. This idea was probably borrowed from the Indians. In some locations, supplying water for the bees becomes a problem. It has been found that a colony needs about a pint of water a day to maintain the bees in good condition. Where water is not available within a reasonable distance from the apiary, the beekeeper must haul it.

Back in 1872 it would have required unusual faculties on the part of General Allen to have visioned the value of the industry he was initiating. Even today it is difficult to grasp the full import of maintaining a healthy bee industry. Fortunate it is for the State that, during the three quarters of a century which have elapsed since bees were first brought to Arizona, the expansion of bee culture has kept pace with the rapid development of agriculture. THE END.

(Reprinted from the September 1950 issue of "Arizona Highways," through the courtesy of the editor, Raymond Carlson, and the permission of the author, Frank Todd.)

Rudy A. Simonson Receives Gold Medal

Rudy A. Simonson, Reclamation engineer aide at Elverta, Calif., was presented with the Interior Gold Medal for Distinguished Service by Assistant Secretary of the Interior William E. Warne on April 27, 1951, for "heroism, involving personal risk over and beyond the call of duty."

For 4 days, much of the time during the blizzard of March 1950, Mr. Simonson insisted upon trying to save the life of his chief, Ardis G. Ribbeck, Chief of the General Engineering Section. On Thursday evening, March 9, 1950, Ribbeck and Simonson were on a reconnaissance trip near Klamath Falls, Oreg. Shortly after noon the next day, they ran into a severe snowstorm, had to abandon their car because of impassable roads, and began to search for food and adequate shelter. Mr. Ribbeck became progressively weaker from

(Please turn to page 232)

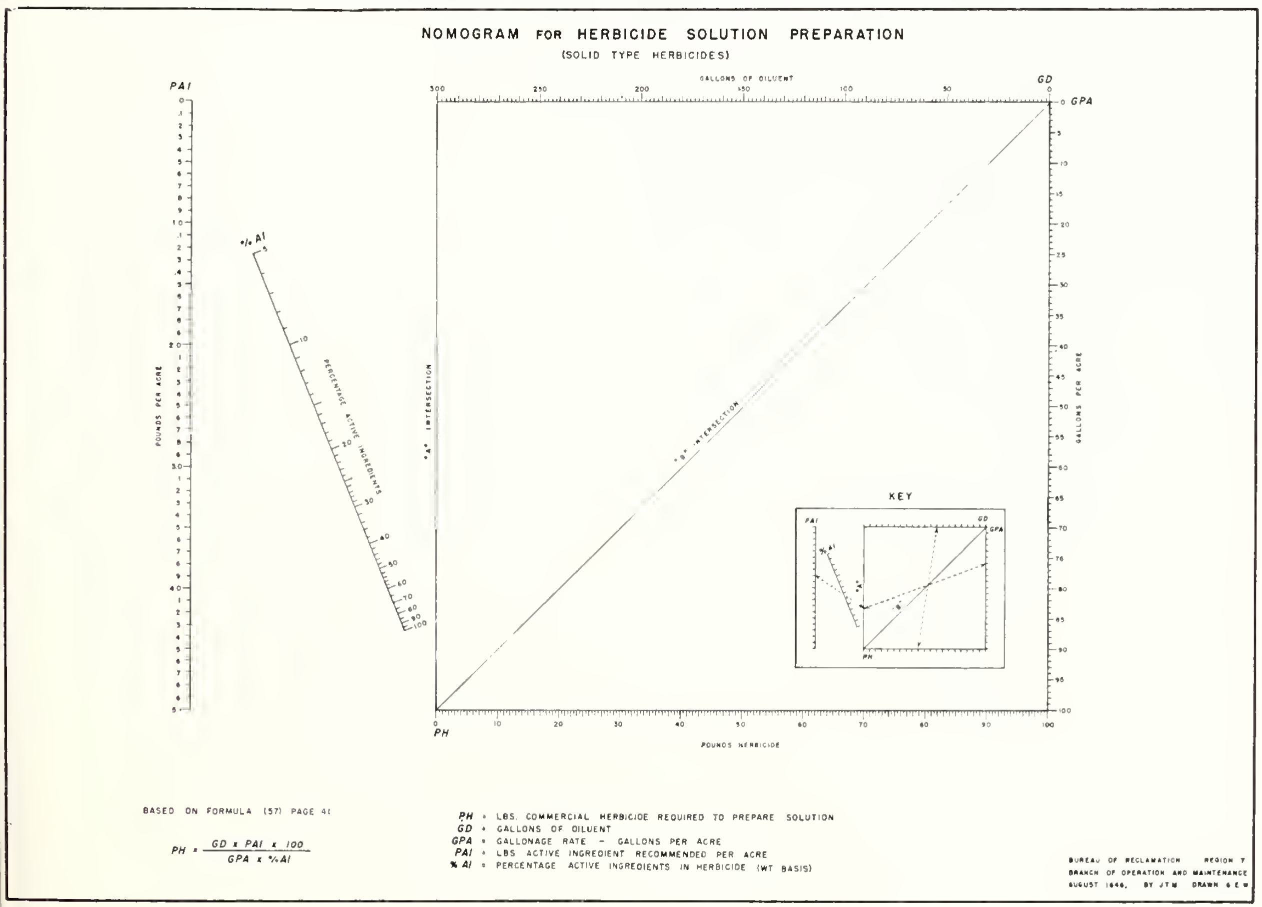
SHORT CUTS TO WEED KILLING CALCULATIONS

PART 5—Preparing Weed Killing Solutions With Powder

by JOHN T. MALETIC, Weed Specialist and Soil Scientist
Region 7 Headquarters, Denver, Colo.

Many of the weed killing chemicals now available come in powder form. Some examples are 2,4-D acid, ammonium salt of 2,4-D, anhydrous sodium salt of 2,4-D, monohydrate sodium salt of 2,4-D, a new amine salt of 2,4-D, sodium pentachlorophenate, polyborchlorate, sodium trichloroacetate (TCA), potassium cyanate (KOCN), ammonium sulfamate (ammate), and phenyl mercuric acetate (PMAS). When using powder type chemicals, such as these, a solution has to be prepared by mixing the chemical with water or some other diluting agent. Often, as in the case of 2,4-D products, the recommendations specify that a certain amount of the active ingredients must be applied per acre to get best results. The question then comes up, "How much chemical should be mixed with water to get the desired application rate?" The answer has two parts: (1) calibrate the rig (see last month's article in this series for the procedure) and (2) use data appearing on the label of the product and the calibration information to figure the amount of chemical to use. If you are using a powder type chemical, you can get the answer quickly from the nomogram below.

Here is what you have to know: (1) The amount of active ingredients in the chemical weed killer, (2) the chemical application rate in terms of pounds of active ingredients to be applied per acre, (3) the amount of water to be used in gallons, and (4) the gallonage rate in terms of gallons per acre (determined during calibration). These values all appear on the scales of the nomogram and all you have to do is to connect the values with a transparent straight edge as shown in the key to get the answer to your problem. If you have a small spraying job to do (when only 5–10 lbs. of chemical are needed), we recommend you use the formula to get the answer because the width of lines on the nomogram will throw your answer off enough to be of importance. All you have to do to use the formula is to multiply the gallons of water to be used by the pounds active ingredients to be applied per acre—call this Product 1. Then, multiply the gallonage rate (gallons per acre) by the percentage active ingredients in the chemical—call this Product 2. Next, divide Product 2 into Product 1 and multiply your result by 100.



Rudy A. Simonson Receives Gold Medal

(Continued from page 229)

exhaustion and exposure, but insisted that Simonson leave and attempt to save his own life. Simonson refused and did everything possible to protect Mr. Ribbeck. After Ribbeck lost consciousness, Simonson prepared a makeshift shelter but was unable to build a fire because of lack of dry materials. He watched over Ribbeck through Friday night, and in the morning located an abandoned cabin where he lit a fire. Returning to Ribbeck, Simonson managed to get him to the cabin where he tried to revive him. It was too late, and Simonson remained with the dead man's body from Saturday until the following Monday morning at 4:30 a. m., when a rescue party arrived. ●

District Counsel Stoutemyer Dies

Bernard E. Stoutemyer, retired district counsel of the Bureau of Reclamation died at Portland, Oreg., on May 22, 1951, at the age of 72, after a long illness. Mr. Stoutemyer's passing will be noted with regret by all the old timers of the Bureau who will recall him as one of the most outstanding lawyers in the field of reclamation law, having served 37 years of continuous service in the legal ranks of the Bureau.

Mr. Stoutemyer, born in New Orleans, La., was a graduate of the Law School of the University of Michigan, and was appointed assistant examiner of the United States Reclamation Service at Boise, Idaho, in December 1906. He was a district counsel between 1919 and 1944, with headquarters at Boise, Idaho, until 1926, and at Portland, Oreg., from 1927 to 1944.

He was an outstanding trial and water rights attorney and a distinguished pioneer in the development of the principle of multiple-purpose projects of the Bureau in the Pacific Northwest. Readers of the Reclamation Era may remember his unusual series, entitled, "The Legal Status of Water Rights in the Pacific Northwest" which appeared in 1935 and 1936, setting forth the nature and complexities of the law of water rights affecting reclamation projects in Oregon, Idaho, and the State of Washington.

Edward W. Fisher, chief counsel of the Bureau, on learning of his death, said, "Mr. Stoutemyer's long association in the Bureau has contributed richly not only to those of us whose lives he touched personally throughout the years but also, in a much larger sense, to the innumerable undertakings which are now reaching full stature of accomplishment in the development of the Northwest. The understanding and assistance he so freely gave to these ends with unselfish devotion will long provide a firm foundation and continuing guide to reclamation development throughout the West." ●

Canal Designer Receives Award

When it comes to design, Harry R. McBirney is to the thousands of miles of canals what Jack Savage is to the many dams on the 60-plus Bureau of Reclamation projects. Because of his efforts over 40 years to make the Bureau of Reclamation irrigation canals, the best, biggest, most economical, and yet serve the greatest number of people, Harry McBirney was recently awarded the Interior gold medal for distinguished service.

He retired last July 31 after holding the position of chief of the canals division in the Office of the Chief Engineer in Denver since 1927. During the years when great Reclamation dams were being designed to prevent the flow of water to the sea, McBirney was busy designing canals, tunnels, and diversion structures which would get the water to the thirsty lands and thus accomplish the end means for which Reclamation is intended—irrigation. Stored water behind dams without charted courses throughout the countryside to its final destination, the land, would hardly benefit the people except through power. Through McBirney's ingenuity the water served twofold purposes in many instances—first, to develop hydroelectric power, and second, after pouring through the turbines, it served as an irrigation source for downstream parched lands.

His outstanding works include the river-size Friant Kern Canal on the Central Valley project, and the All-American Canal which carries the Colorado River into the rich Imperial Valley of California. He also supervised the design of the gigantic canal distribution systems on the Columbia Basin project, in Arizona-Nevada, and Colorado Big Thompson project in Colorado.

He began his Government career with the Interior Department's General Land Office in 1907–08, joining the Reclamation Service, later the Bureau of Reclamation, shortly thereafter. He is a native of Conrad, Iowa. ●

America Needs All of Us

(Continued from page 213)

sense to every man who has the responsibility of staffing a job, whether it be construction, shop work, farming, or a business office.

You talk to Ed Sizer, electrician for G-S-M, who had his right leg blown off just below the knee when he and 26 other members of a First Marines' observation post were caught in a deadly hail of machine gun and rocket fire behind the Japanese lines in Okinawa. Today, Ed skis, skates, swims, and packs a bowling average as high as 169. The determination and the will to succeed that have enabled Ed to overcome his handicap and engage successfully in these sports are the qualities that make him a valued employee in the G-S-M organization. Ed's artificial leg doesn't bother him much. In fact, he seems to be much more sensitive about his receding hairline—always bowls with a cap on.

At the contractor's heavy-duty machine shop, you run across Art Stratton who has to be careful that he doesn't weld the hook that serves as his right hand to the tractor frame he is working on. Art lost his arm and his right leg under a railroad car many years ago, but the tragic accident didn't keep him from doing his part as a welder in the Lake Washington shipyard during the Second World War. He's been on the Hungry Horse job for 3 years, and his shop foreman, Leo Leifester, says welders don't come any better than Art.

It is significant that a majority of the physically handicapped men on the Hungry Horse job are employed as cableway operators or cableway signalmen. This is startling, to say the least, when you realize the tremendous responsibility that rests on the shoulders of the men who fill these jobs. They are key men in a high-speed operation that keeps concrete moving from the mixing plant to the dam at an average rate of 7,600 cubic yards, or 30,400,000 pounds every 24 hours.

You make the long climb to the operators' tower anchored high on the canyon wall and step into one of the glass-enclosed booths. Through the window in front of the operator you see the 139-foot high concrete mixing plant and Montana's

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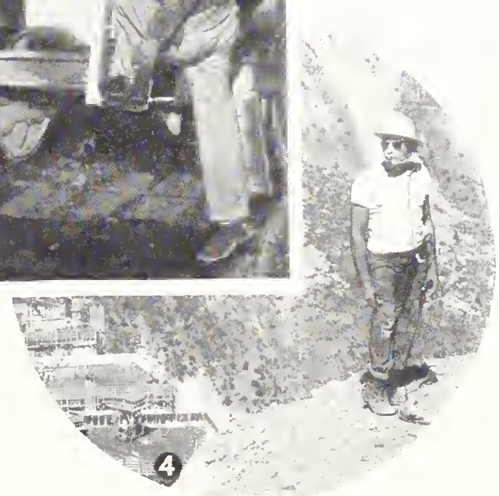


4

HE CAME BACK—Alton C. (Al) Black (top) operates cableway after 65-foot fall. John McKee carries on as signalman despite lost right arm. Cal Crouch once a polio victim, now a winner (at right), chats with Martin Kortuem. Alvin E. Hendrickson who spent 13 years in hospital now calls signals for Hungry Horse. ***All photos by James Clausen, Region 1.***

GIRL'S BEST FRIEND with Jean Cameron (top). Engineer Stuart M. Blydenburgh operating slide rule with ease. Settler William S. Lovercheck (at right), lower photo, doesn't let his injuries interfere with developing his Columbia Basin farm at Pasco, Wash.

shortest and busiest railroad on which Diesel powered "dinkies" shuttle back and forth carrying concrete from the mixing plant to the cableway buckets. The operator leans forward tensely and his hand flicks over the controls quickly and surely in response to a series of flashing lights and staccato buzzer signals. Then, through a speaker, comes the low voice of the operator's signalman, "Give us a little headtower, Ralph—easy, hold it—now bring her down a bit. This is a tight spot—not much clearance—O. K., dump her and highball it." Following the operator's eyes, you see the big 8-cubic-yard concrete bucket leap skyward as it drops its 16-ton load of concrete in one of the massive concrete blocks rising in the river canyon.

As he flips the controls that swing the bucket back across the canyon to the loading dock, cableway operator Ralph Olson turns and greets you.

Then you make a surprising discovery. Ralph is literally bolted to his job. A special steel joint, designed by Ralph and machined in the General-Shea-Morrison machine shop, connects his artificial left arm with the cableway speed control. The special joint, which has a ball-bearing swivel to give it the smooth flexibility of a man's normal wrist, screws on to the artificial arm and bolts firmly to the speed control handle.

You learn that Ralph lost his left arm above the elbow 17 years ago when his car was sideswiped by a truck. He broke in as a cableway operator at Shasta Dam in 1941 and has been operating cableways steadily since that time. You learn from other men on the job that he is one of the best.

You drop to the operator's tower on the graveyard shift and talk to Al Black who started operating a cableway at Hungry Horse in April 1951. Al worked as a signalman at Hungry Horse last year—his first job since his recovery from almost fatal injuries received in a 65-foot fall from a whirly crane at Davis Dam in 1947. Al's permanent injuries include a crippled left arm from which the elbow joint has been removed, and a crippled left leg. But his bad left arm handles the cableway controls as quickly and surely as his good right arm.

Physically handicapped signalmen working on the Hungry Horse job include John McKee who lost his right arm above the elbow in a logging accident. He also wears a brace on his paralyzed right leg.

Then there's Al Hendrickson who spent 13 of his first 15 years in hospitals fighting TB of the spine and leg. He started working at the project as a guard in 1948, later tried his hand at clearing work in the 34-mile long reservoir area, and then returned to the dam where he was a checker at the mixing plant for a time before starting his present work as signalman.

Up at the concrete mixing plant, Cal Crouch, dock foreman, gets around with amazing agility, in spite of his polio-crippled left leg. Cal works the graveyard shift, supervising clean-up in the busiest and most dangerous spot on the Hungry Horse job.

Looking back on your hurried trip over the project and your talks with these men who are doing their jobs in spite of lost or maimed arms and legs, you wonder a little that you haven't realized before how many there are on the job. And then the truth dawns on you. They are doing their jobs so quietly and so efficiently that you just don't realize that they have physical handicaps.

COLUMBIA BASIN PROJECT

Of the approximately 2,000 employees of the Columbia Basin district in the State of Washington, a quick count reveals approximately 175 are 10-point preference veterans.

Typical of these is Ellis Shorthill, photographer, who was in the Pacific Theatre when he received a head injury from an exploding grenade, which paralyzed him completely. After about 3 months in an American hospital during which time he regained his ability to walk, he was captured by the Japanese and was a prisoner of war for 2½ years. He continues to have difficulty with the left side of his body but the handicap does not prevent him from doing good photographic work—see page 217 of this issue.

William S. Lovercheck, a World War II paratrooper living on Irrigation Block 1 of the Columbia Basin project, has overcome his serious wartime injuries so well that very few people can tell the extent to which his injuries interfere, if at all, with his farming.

JEAN CAMERON

Blind since birth, Miss Jean Cameron, an employee in the Commissioner's Staff Offices in Denver, has proved that a physical handicap is not of necessity a deterrent to the leading of a full and happy life.

Jean is employed as a dictating machine transcriber. She came to Reclamation in 1944 as a stenographer transferring from Lowry Air Force Base in Denver where she had been employed as a clerk-typist for a year and a half.

Jean and her seeing-eye dog, Mabel, have become an essential part of the environment in the Bureau of Reclamation offices at the Denver Federal Center. Jean arrives at her job every morning in her own automobile. An extremely satisfactory arrangement with fellow workers who live in her neighborhood whereby they drive and Jean rides, permits her the comfort of personal transportation to and from her office.

Born in Lehi, Utah, Jean attended the Colorado School for the Deaf and Blind in Colorado Springs, Colo. In 1933 she enrolled at Colorado Woman's College in Denver, concentrating on psychology, history, social sciences, and Spanish. She completed the prescribed 2-year course, and was awarded an associate in arts degree in 1935.

She is an accomplished vocalist, plays the piano and organ, and has had magazine articles published. She is keenly interested in music, stage plays, and movies. Her "handicap" in no way hinders Jean's full participation in practically all types of social activity.

In her present position as dictating machine transcriber, one of Jean's principal tasks is the transcription of the proceedings of meetings in which several speakers participate. Following the initial introductions, Jean depends solely upon the speaker's voice for identification. Final preparation of drafts of the proceedings is also her responsibility. An award for superior accomplishment in 1948 and consistently high yearly efficiency ratings attest to Jean's capability.

It seems incongruous to speak of Jean Cameron as "handicapped." Her ability and her independence exceed that of many who have complete possession of their physical faculties. Those who know her well are quick to point out her ability to be the "life" of any gathering in which she may participate. Her cheerfulness, ability, and lively interest in all aspects of life provide a model for any who know Jean Cameron.

STUART M. BLYDENBURGH

"Stu" Blydenburgh was employed by the Bureau of Reclamation in 1949, following his graduation from Case Institute of Technology in Cleveland, Ohio. He was awarded a bachelor of science degree in Civil Engineering from this institution in June 1949. Prior to his entry into the Army, he attended Ohio Wesleyan University for 2 years. Summer employment between semesters as an engineering aide with the Buffalo District Office of the United States Corps of Engineers preceded his permanent employment by the Bureau of Reclamation.

Shrapnel wounds while in action in France in 1944 resulted in the loss of Stu's left arm. This loss has affected neither his desire nor his ability to get ahead.

Mr. Blydenburgh is now assigned to the Special Assignments Section of the Dams Branch in the Division of Design and Construction in Denver. He recently completed a series of the rotation assignments in which many of the Bureau's young engineers participate. Stu's ability to do an outstanding job has been recognized by a recent raise in grade and salary.

As a civil engineer in the Structural Behavior Unit of the Special Assignments Section, Stu is responsible for preparing detailed drawings from rough sketches, notes, and oral instructions. He also assists in the compilation and analysis of data received from field offices in the form of reports and instrument readings.

Stu's missing left arm has not affected his ability to perform high-caliber work. Equipped with a prosthetic limb, he has become proficient in its use. It permits him, for example, to hold the steering wheel of his auto or to pick up objects if the occasion demands.

Stu's supervisors have rated as "outstanding" his dependability and his willingness to cooperate in the accomplishment of work to be done.

HARRISON J. HURLBURT

A little more than a year ago, on September 14, 1951, to be exact, a strapping air corps veteran walked into the Bureau of Reclamation's Yakima project office in the State of Washington. He was a lucky winner of one of the 11 Roza homesteads. The ex-lieutenant, who had lost his foot in the service of his country, had come to claim his farm.

This year, farmer Hurlburt has an artificial limb and is not dependent any more on the use of crutches. In the meantime, he has raised over 50 acres of crops—25 acres of peas, planted with alfalfa that will be raised for seed, 17 acres of red Mexican beans, and 12 acres of sweet corn—doing most all the work by himself, with the aid of his faithful tractor. Except initial planting and harvesting, Mr. Hurlburt estimates he has not spent over $50 for outside labor.

He even built his own house, obtaining it from the White Bluffs area (Hanford Atomic Energy works vicinity), had it moved in three sections, built his own foundation, and reassembled it with the aid of one other man. He has electric power and hopes to obtain domestic water through a proposed cooperative well agreement of neighboring farmers.

Hurlburt has invested all of his capital in the farm and plans to stay with it—says it is too short a time yet to decide whether or not he will be successful, but doctors have certified that he has the makings of a successful farmer and is equal to most others.

On page 125 of the July 1951 issue appears another example of a wounded World War II veteran who made good on his "Home in the West." The End.

Buckeye County Water Contract OK'D

William E. Warne, Acting Secretary of the Interior, on July 3, 1951, approved the form of contract under which the Bureau of Reclamation's Central Valley project will supply municipal and industrial water to Buckeye County Water District in California.

The contract has been sent to the district which will hold an election for the purpose of voting to sign the contract, in the near future.

The Buckeye County District is located near Redding, California, in an area of the larger lumber and mining centers of Northern California. Availability of Central Valley's hydroelectric power and water is expected to result in an expanding population and a growing industrial section. Municipal and industrial water now obtained from wells is insufficient to meet this anticipated expansion.

The contract provides for replacing an outmoded pipeline now carrying water from Shasta Dam to a Government Camp at Toyon and other customers. The old pipeline is insufficient in size and capacity to serve the present expanded area. This new line will serve the Buckeye District as well. Under the contract the district is scheduled to pay $20 per acre foot for municipal and industrial water, and agrees to accept and pay in advance annually for 45 acre-feet for the first 5 years of operation. ●

N. R. A. Convention Scheduled

The twentieth annual convention of the National Reclamation Association will be held in Amarillo, Tex., October 17, 18, and 19. Headquarters for the convention will be the Herring Hotel. ●

Reclamation Boosts Population

One of the favorite sayings of Senator Francis Newlands of Nevada was, "Every city in America grows to the West," and most everyone is familiar with the famous Horace Greeley quotation instructing young men on the most desirable point of the compass to follow.

Census Bureau population figures indicate the validity of Senator Newlands' observation, and the results of Mr. Greeley's suggestion. The young men (and women, too, evidently) went to the West, until the preliminary 1950 figures show that during the last 10 years the 17 Western States had a population boom of 24.9 percent compared to the rise in population of the entire United States at 14.3 percent.

Many factors contribute to population trends, but it seems more than a coincidence that the States with the greatest amount of reclamation activity are those in which the greatest increases occurred during the past decade.

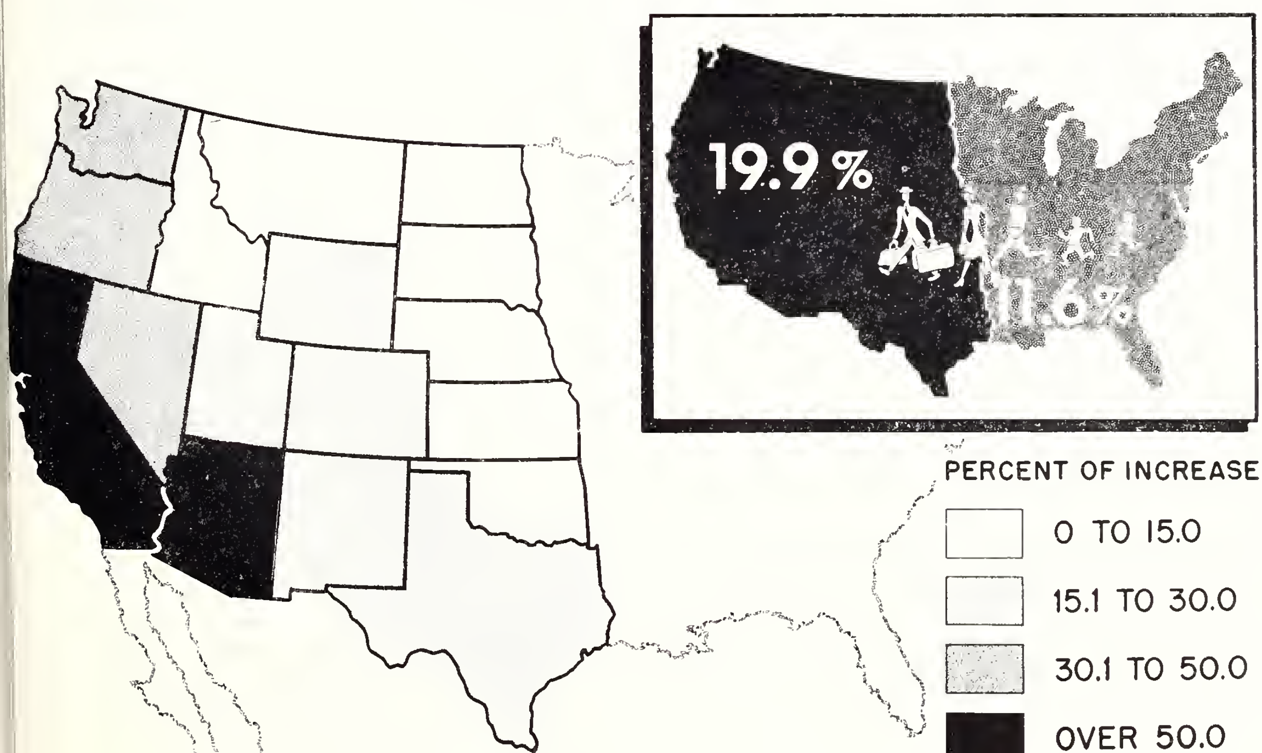
The accompanying map graphically indicates the difference between the growth of the East and the West, and here is a break-down of the preliminary Census Bureau figures for the 17 Reclamation States:

CENSUS BUREAU

Population Figures—17 Western States

Rank in Nation	State	Population		Change 1940–50	Percent of change	
		1940	1950 [1]		1930–40	1940–50
38	Arizona	499, 261	745, 259	245, 998	14. 6	49. 3
2	California	6, 907, 387	10, 490, 070	3, 582, 683	21. 7	51. 9
34	Colorado	1, 123, 296	1, 318, 048	194, 752	8. 4	17. 3
44	Idaho	524, 873	585, 092	60, 219	17. 9	11. 5
31	Kansas	1, 801, 028	1, 894, 390	93, 362	−4. 3	5. 2
43	Montana	559, 456	587, 337	27, 881	4. 1	5. 0
33	Nebraska	1, 315, 834	1, 318, 079	2, 245	−4. 5	. 2
49	Nevada	110, 247	158, 283	48, 036	21. 1	43. 6
40	New Mexico	531, 818	677, 152	145, 334	25. 6	27. 3
42	North Dakota	641, 935	617, 965	−23, 970	−5. 7	−3. 7
25	Oklahoma	2, 336, 434	2, 223, 650	−112, 784	−2. 5	−4. 8
32	Oregon	1, 089, 684	1, 512, 100	422, 416	14. 2	38. 8
41	South Dakota	642, 961	650, 029	7, 068	−7. 2	1. 1
6	Texas	6, 414, 824	7, 677, 832	1, 263, 008	10. 1	19. 7
39	Utah	550, 310	686, 797	136, 487	8. 4	24. 8
23	Washington	1, 736, 191	2, 363, 289	627, 098	11. 1	36. 1
48	Wyoming	250, 742	288, 800	38, 058	11. 2	15. 2
	Total	27, 036, 281	33, 794, 172	6, 757, 891	+9. 2	+24. 9

[1] 1950 Census of Population Release Nov. 5, 1950, Bureau of Census U. S. Dept. of Commerce.



WATER REPORT

The extreme, long-continued drought in the lower Colorado River Basin, including the Verde and Salt River subbasins, was broken by storms August 28–30. From 3 to 5 inches of rain were measured at a number of gaging stations in central and western Arizona during those 3 days. Unfortunately, the drought still continued, with but little relief, in New Mexico and Texas. Irrigation water supplies were plentiful over most of the remainder of the 17 Western States, as of the first of September.

By regions (see map on back cover for locations) the irrigation water supply situation is as follows:

REGION 1—The outlook remained generally excellent. Two pump units at Grand Coulee Dam were operated continuously throughout the month of August, pumping a total of 172,000 acre-feet of water into the Grand Coulee equalizing reservoir. Initial diversion from the equalizing reservoir began on August 10, with a total of 59,580 acre-feet being diverted into Long Lake and the Columbia Basin project distribution system during the remainder of the month.

REGION 2—Inflow into both Shasta and Millerton Lakes was a little above normal for the month of August. The first pumps were placed in operation at the Tracy pumping plant, and for the first time, Sacramento River water was transferred to the San Joaquin River Basin, through the Delta-Mendota Canal. Irrigation water supplies will be sufficient over all of the Central Valley project except for the Friant-Kern and Madera Canal service areas below Millerton Lake where the supply remains subnormal.

REGION 3—Storage in Lake Mead remained below normal although storms during the latter part of August on the upper watershed indicated increased storage in September. Combined storage in the Salt River project reservoirs was about 260,000 acre-feet on August 31, an increase of 150,000 acre-feet over the storage in the same reservoirs on July 31. This will be extremely helpful for the balance of the current year, but is still well below average.

REGION 4—There was sufficient rainfall in previously dry areas to improve the over-all water picture materially. By the first of September all projects were assured sufficient water for maturing normal crops.

REGION 5—Water supplies were plentiful on the W. C. Austin and Tucumcari projects, but there was little or no relief from drought in southern New Mexico and Texas. Alamogordo Reservoir, on the Pecos River, which was empty on August 1, received sufficient inflow during the month to provide storage of 12,500 acre-feet on August 31. McMillan and Avalon Reservoirs were practically empty, however, on that date. Inflow of 10,000 acre-feet was recorded at Elephant Butte Reservoir, but total storage in Elephant Butte and Caballo Reservoirs at the end of August was down to a total of 45,000 acre-feet, setting another new record low.

REGIONS 6 AND 7—Irrigation prospects continued from good to excellent on all projects except the Belle Fourche in South Dakota. Even there, however, the water supply will be sufficient for production of normal crops, but with little holdover storage in prospect in the Belle Fourche Reservoir. ●

CROPS

Central Valley and Coachella Crops Hit Peak

On the Central Valley project in California, the gross value of crops grown during 1950 was $103,014,000. This marked the highest return on any one Reclamation project for the year. Among the high priced crops grown were cotton, fruit, and grapes, with cotton showing the way.

On the Coachella Division of the All American Canal system in California an average of $433 per-acre value was chalked up during the year to lead all other Reclamation projects on the per-acre basis return. The high per-acre value received on this project was due principally to the large acreages of fruit and truck crops, mainly string beans, sweet corn, and dates. ●

LETTERS

"Unsung Benefits" Being Sung

1338 CAPITOL AVENUE,
DES MOINES, IOWA,
June 23, 1951.

DEAR MISS SADLER: I seem to recall that I wrote you a letter, thanking you for allowing me to use the essay by Lee Watenpaugh in my manuscript on water. But since I cannot locate the carbon I may have only intended to, and never did. Anyway, it's better to send two, and be sure about it than to fail to write. And so I do thank you for so kindly allowing me to use this excellent essay of Lee's: I am sure it will help my book to have appeal for children.

Yours sincerely,

IVAH GREEN.

(Lee Watenpaugh's manuscript, "Irrigation's Unsung Benefits" which appeared in the June 1951 issue has been picked up by many publications, not the least of which was the Congressional Record, issue of June 11, 1951, in which it was introduced by Congressman John R. Murdock of Arizona.—Ed)

Love That Lubbock!

LUBBOCK, TEX.,
May 17, 1951.

MR. E. D. EATON, *Director,*
Branch of Operation and Maintenance,
Bureau of Reclamation,
Washington, D. C.

DEAR MR. EATON: Thank you very much for the three copies of the March 1951 issue of RECLAMATION ERA which carried a picture of Lubbock. May we also take this opportunity to praise Mr. Garford Wilkinson and the staff of RECLAMATION ERA for the excellent treatment of the Canadian River project feature.

If we can ever be of further service to you, please do not hesitate to let us know.

Again, thank you for your letter and the magazines.

Sincerely yours,

OTICE A. GREEN,
LUBBOCK CHAMBER OF COMMERCE.

RELEASES

Hollywood Says "Water in the West" is "Finest Film"

Among the congratulatory letters received from members of the television and screen industry regarding the Reclamation film entitled, "Water in the West" was one from Robert Guggenheim, manager of Film Operations for Hollywood, Calif., Television Station KNBH, in which he said, ". . . this is the finest documentary—even governmental documentary—film it has been my pleaseure to see. We believe the minimum audience for your showing (set for June 23d) will be approximately three hundred thousand viewers with the potential audience somewhere far above that estimate.

". . . Its presentation, as well, with the complete music cue sheet, et cetera, has been one of the best we have been offered from any source." ●

New Project Folders Available

New project folders for the Boise and lumbia Basin projects, and the Boy- n and Canyon Ferry Units of the ssouri River Basin projects are now ailable to the public. These are ıstrated and contain a number of eresting statistics in addition to a mmary narrative on each of the ojects.

There is no charge for the folders. pies may be obtained by writing to pply Services Division (Attention: 1), Bureau of Reclamation, Denver deral Center, Denver, Colo.

In addition to the above, the Bureau s published an illustrated 22-page oklet entitled "Working Water" which scribes the Central Valley Project California. Copies of this booklet ay be purchased for 25 cents from e Superintendent of Documents, Gov- nment Printing Office, Washington , D. C. ●

eclamation Manual Aids Solution of World Water Problems

The Bureau of Reclamation's Man- l, 20 volumes of technical, engineer- g, and administrative experience cumulated during the past half cen- ry, is helping nearly 50 foreign gov- nments and private engineering firms solve water conservation problems l over the world.

Lessons learned the hard way by the ıreau which has built the largest dams d power plants in the world are also rving as text books for engineering udents in more than 20 American uni- rsities and colleges. At the same ne, 26 U. S. Government and 27 State d municipal agencies are benefiting om the "housekeeping" or administra- e and technical information in the ıreau's manual. This information is de available to those seeking it at nominal cost. ●

TVA Releases Kentucky Project Report

The Tennessee Valley Authority an- nnces the publication of Technical Eport No. 13 on the planning, design, cstruction, and initial operation of th Kentucky project on the Tennessee Ever. Besides the importance of the Kntucky project in the over-all system operations and as a point of public interest, its layout, design, and construction involved problems and methods of particular interest to engineers and constructors engaged in similar river-control work. The report contains 877 pages, including 307 illustrations and exhibits.

The report covers in detail preliminary investigations for the project, including geology and river flow; dam and powerhouse design; construction methods, including construction plant, river diversion, employee housing, and access facilities; relocations and adjustments in the reservoir area; initial operations; and a complete summary of the project costs. The appendixes include a complete statistical summary of physical features of the project; reports of the engineering and geologic consultants; summaries of hydraulic studies; a summary of design of Kentucky Dam against earthquake; and lists of classified construction equipment and major purchases of material and equipment. Bibliographies on each phase of the project are also included.

The Kentucky Project may be procured from the Tennessee Valley Authority, Treasurer's Office, Knoxville, Tennessee, for $3.25. Other published reports in this series include: The Norris Project, published in 1939; The Wheeler Project, 1940; The Pickwick Landing Project, 1941; The Guntersville Project, 1941; The Chickamauga Project, 1942; The Cherokee Project, 1946; The Hiwassee Valley Projects, Volume 1, 1946; The Hiwassee Valley Projects, Volume 2, 1947; The Douglas Project, 1948; The Watts Bar Project, 1948; The Watts Bar Steam Plant, 1948; The Fort Loudoun Project, 1949; and The Fontana Project, 1949. Except for the Norris, Wheeler, and Pickwick project reports, which are out of print, these reports in limited quantity are currently available from the Tennessee Valley Authority, Treasurer's Office, Knoxville, Tennessee. ●

New Maps Available

Two new project maps have been released by the Bureau of Reclamation, as follows: Cachuma Project, Calif., and Sun River Project, Mont. These maps are all in color. The Cachuma map is available in two standard sizes, 10½ by 17 inches and 21 by 34 inches. The Sun River map is available in the 10½ by 17 inch size. Those who wish to obtain these maps should send their requests to their nearest regional director (see directory on inside back cover of this issue), and specify name and size of maps desired. Single copies are free to those who have need of them in connection with their work or studies.

POSTSCRIPTS

Adjustable "Squelch" for Radiophones

A new version of a portable FM radiophone has recently been introduced with an adjustable squelch which cuts down on tube and circuit noises up to 25 to 50 decibals. The adjustable squelch, which is mounted on the power supply chassis, is also claimed to eliminate any possible audio distortion resulting from using the portables in fringe areas. Further information may be obtained from Motorola's Technical Information Center, Communications and Electronics Division, 4545 West Augusta Boulevard, Chicago 51, Ill.

Conservationist's Prayer at Eventide

Lord of the sunset, the forests, and the water, grant me the peace to accept those things that are immutable, grant me the courage to change those things that may be changed, and grant me the wisdom to know the difference.

(From the inside back cover of the August 1951 issue of the *Missouri Conservationist* published monthly by the Missouri Conservation Commission.)

The average size of American farms has not increased significantly in the last 80 years; the typical farm remains a family-sized production unit, says a Twentieth Century Fund report.

John MacGilchrist, of the Division of Design and Construction, Denver, Colo., whose signature appeared on the upper left hand drawing on page 198 of last month's issue, also produced the other drawings on pages 198 and 199. The Washington, D. C. Graphics section prepared the map.

T. R. Broderick, not Charles A. Knell, was the photographer for the photo on page 193, September 1951 issue. Charlie took the picture on page 192.

NOTES FOR CONTRACTORS

Contracts Awarded During August 1951

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DS-3396	Central Valley, Calif.	Aug. 6	3 lots of steel manifolds for pumping plants S4, S5, S6, S7, S8, S9, S12, S13, and S14 on laterals 124.5E, 127.7E, and 130.4E, unit 3, Southern San Joaquin municipal utility district, Friant-Kern canal distribution system.	The Lang Co., Inc., Salt Lake City, Utah.	$24,
DS-3428	Columbia Basin, Wash.	Aug. 3	3 vertical-shaft turbine-type pumping units for Lower Scooteney pumping plant (PE-27) and Upper Scooteney pumping plant (PE-27A), Potholes East Canal laterals, area P-2, schedule 1.	Pump & Equipment Co., Seattle, Wash.	51,
DS-3436	Central Valley, Calif.	Aug. 23	1 motor-control switchgear assembly and 1 112.5-kv-a transformer for Trauger pumping plant.	Westinghouse Electric Corp., Denver, Colo.	49,
DS-3450	Boulder Canyon, Ariz.-Nev.	Aug. 14	3 current and 3 potential transformers for Metropolitan water district—Southern California Edison Co. tie line. Hoover switchyards.	General Electric Co., Denver, Colo.	45,
DS-3452	Columbia Basin, Wash.	Aug. 20	1 power transformer with 3 lightning arresters for Babcock pumping plant switchyard, schedule 1.	General Electric Co., Denver, Colo.	18,
DC-3455	Klamath, Oreg.	Aug. 1	Construction of earthwork and structures for N canal area, second extension on Tule Lake sump, and outlet structures for pumping plant No. 6.	George R. Stacy, Tule Lake, Calif.	99,
DS-3461	Central Valley, Calif.	Aug. 29	6 motor-driven, vertical-shaft pumping units for Columbia canal pumping plant No. 1 and Mowry canal pumping plant, schedule 1.	Food Machinery and Chemical Corp., Los Angeles, Calif.	30,
DS-3462	Columbia Basin, Wash.	Aug. 20	1 power transformer with 3 lightning arresters for Upper Saddle Gap pumping plant switchyard, schedule 1.	Moloney Electric Co., St. Louis, Mo.	14,
DS-3464	Colorado-Big Thompson, Colo.	Aug. 17	1 motor-control switchgear assembly and one spare circuit breaker removable element for Willow Creek pumping plant.	Westinghouse Electric Corp., Denver, Colo.	30,
DS-3466	Missouri River Basin	Aug. 3	4 carbon-dioxide fire-extinguishing systems and 35 cylinders of carbon dioxide for Boysen and Canyon Ferry power plants.	C-O-Two Fire Equipment Co., Newark, N. J.	$10,
DC-3468	Hungry Horse	Aug. 7	Furnishing and installing 1 electric elevator in control bay	Elevator Maintenance Co., Ltd., Los Angeles, Calif.	41,
DS-3469	Columbia Basin	Aug. 10	3 vertical-shaft pumping units for Ringold pumping plant, Potholes East canal, area P-8.	Economy Pumps, Inc., Hamilton, Ohio.	41,
DS-3472	Missouri River Basin	Aug. 8	1 main control board for Huron substation, schedule 1	Nelson Electric Mfg. Co., Tulsa, Okla.	14,
DS-3472	do	do	3 main control boards for Mount Vernon, Sioux Falls, and Watertown substations, schedules 2, 3, and 4.	Kirkhof Electric Co., Grand Rapids, Mich.	44,
DS-3475	Colorado-Big Thompson, Colo.	Aug. 29	2 84-inch butterfly valves for penstock intake at Flatiron power and pumping plant.	The Pelton Water Wheel Co., San Francisco, Calif.	73,
DC-3481	Missouri River Basin	Aug. 8	Construction of 10,000-kv-a. Woonsocket substation	Main Electric, Inc., Minot, N. Dak.	38,
DC-3494	Columbia Basin	Aug. 22	Construction of earthwork and structures for Potholes East canal, Ringold wasteway, and lateral PE-47.	Peter Kiewit Sons' Co., Seattle, Wash.	1,358,
DC-3495	do	Aug. 10	Construction of earthwork and structures for Columbia River wasteway turnout, West canal.	J. A. Terteling and Sons, Inc., Boise, Idaho.	48,
DS-3496	Cachuma	Aug. 17	1 54-inch steel outlet pipe and appurtenances for Lauro Dam	California Steel Products Co., Richmond, Calif.	30,
DC-3498	Davis Dam, Ariz.-Nev.	Aug. 23	Construction of headquarters building for system operations and maintenance area near Phoenix.	Daum-Donaldson Construction Co., Inc., Phoenix, Ariz.	448,
100-C-133	Deschutes, Oreg.	Aug. 21	Clearing timber and brush along roads and in Wickiup Reservoir area.	Joe Scott, Boise, Idaho	142,
117-C-105	Columbia Basin, Wash.	Aug. 9	Moving quonset buildings, and constructing streets and utilities at the operation and maintenance headquarters at Eltopia, Wash.	Thompson Construction Co., Kennewick, Wash.	150,
200-C-168	Central Valley, Calif.	Aug. 14	Construction of administration building at Tracy pumping plant.	Merle C. Baldwin, Watsonville, Calif.	111,
300-S-25	Davis Dam, Ariz.	Aug. 7	Power transformers, circuit breakers, and disconnecting switches for Tucson substation.	Pennsylvania Transformer Co., Cannonsburgh, Pa.	231,
600-C-58	Missouri River Basin, N. Dak.	Aug. 29	Warehouses, water supply wells, and storage building for Bismarck, Devils Lake, and Jamestown substations, schedules 3, 5, and 6.	Smith, Inc., Fargo, N. Dak.	186,

Construction and Materials for Which Bids Will Be Requested by December 1951

Project	Description of work or material	Project	Description of work or material
W. C. Austin, Okla.	Construction of 5.5 miles of drains, 3.5 miles of lateral wasteway, 100 c. f. s. capacity, and 1,500 feet of asphalt membrane lining on the 400 c. f. s. capacity Altus canal near Altus, Okla.	Central Valley, Calif.	Constructing Parshall flume or similar measuri device immediately above or below Cottonwoo Creek siphon for measuring water delivered Madera Canal.
Cachuma, Calif.	Construction of Lauro chlorination and control house near Santa Barbara, Calif.	Do.	Surfacing Delta-Mendota canal patrol road in vicinity Tracy pumping plant near Tracy, Calif.
Do.	Construction of 16 miles of 27- to 36-inch diameter concrete pipe conduit and 3 control stations, part of the Carpenteria section of the South Coast conduit near Santa Barbara, Calif.	Do.	Construction of 43 miles of 12- to 42-inch diamet concrete pipe lines for Exeter irrigation district the Friant-Kern Canal distribution system, nea Exeter, Calif.

Construction and Materials for Which Bids Will Be Requested by December 1951—Continued

Project	Description of work or material
Colorado-Big Thompson, Colo.	Construction of the 1,350-foot long, 8-foot diameter Carter Lake pressure conduit about 9 miles west of Loveland, Colo.
Do	Bulkheads and bulkhead gates for Flatiron power and pumping plant.
Do	Hydraulically operated penstock butterfly valve controls for Flatiron power and pumping plant.
Do	Construction of 10 miles of 625- to 575-c. f. s. capacity, partially lined St. Vrain supply canal, including a 50 c. f. s. turnout feeding into the Little Thompson River, two 8.5-foot horseshoe-shape tunnels, totaling 4,350 feet in length, and a 1,300-foot long 8.5-foot circular siphon, the other siphons, chutes, and spillways, near Lyons, Colo.
Colorado River Front Work and Levee System, Ariz.-Nev.-Calif.	Raising and widening the 18-mile reservation levee near Yuma, Ariz.
Columbia Basin, Wash.	Construction of 19 miles of 470 c. f. s. capacity, unlined Potholes East canal, including concrete chute, drop, stilling pools, and 8 concrete checks; construction of Pasco wasteway turnout and chute, and 7 county road bridges, near Ringold, Wash.
Do	Construction of 4.4 miles of distribution system for part-time farm units in block 701 in lateral area W2A on West canal, near Soap Lake, Wash.
Do	Construction of Lower Saddle Gap, Upper Saddle Gap, and PE17 pumping plants of 112, 90, and 15 c. f. s. capacities, including furnishing and erecting prefabricated steel buildings and constructing wasteways, 1,600 feet of lateral, and 20 miles of sublaterals in P1 and P13 lateral areas 5 miles southwest of Othello, Wash.
Do	Construction of Royal watermaster headquarters including 8 concrete-block, wood-frame residences and garages, brick veneer office building, shop building, storehouse, 2 Government garages, streets and utilities; and construction of temporary construction camp consisting of 35 temporary dwelling units, about 7 miles north of Corfu, Wash.
Do	Construction of power distribution system for gate control house and piezometer well; installation of service entrance for the headworks at O'Sullivan dam near Moses Lake, Wash.
Do	Construction of 7 permanent-type, wood-frame, two- and three-bedroom houses with private garages and utilities, at operation and maintenance sites in lateral areas E-2, E-3, P-1 and P-2 on East and Potholes East canals, near Ritell and Othello, Wash.
Do	Drilling exploratory water supply well in part-time farm unit area near Soap Lake, Wash.
Do	Motor-control switchgear for 2,300-volt synchronous and induction motors for Babcock pumping plant.
Davis Dam, Ariz	Erection of steel structures and installation of electrical equipment for 69-kv. switchyard and transformer circuits at Davis Dam, Ariz.
Do	Main control board for 230-kv., 115-kv., and 13.8-kv. circuits for Prescott substation.
Eklutna, Alaska	Four 10,000/12,500-kva. transformers for Eklutna power plant.
Do	Two 50,000 foot-pound capacity governors for the 24,000-hp. Eklutna power plant.
Fort Peck, Mont	Main control board for 115-kv. circuits for Dawson substation.
Gila, Ariz	Construction of 28 miles of 120- to 15-c. f. s. unreinforced concrete-lined Mohawk laterals and sublaterals for Unit 1 near Roll, Ariz.
Hungry Horse, Mont	Furnishing and installing two 10,000-pound capacity, combination freight and passenger elevators.
Kendrick, Wyo	Installing armor rods and vibration dampers and changing overhead ground wire connections on 50 miles of 115-kv. Seminoe-Casper transmission line about 12 miles southwest of Casper, Wyo.
Missouri River Basin, Nebr.	Clearing 2,000 acres of Swanson reservoir area above Trenton dam.
Missouri River Basin, N. Dak.	Furnishing and erecting control buildings and towers for communication facilities in North Dakota.
Missouri River Basin, S. D.	Construction of metal or concrete-block warehouses and storage garages at Armour, Sioux Falls, Watertown, and Philip substations.
Do	Two 7,500-kva., one 15,000-kva., and one 10,000-kva., transformers for Sioux Falls, Mount Vernon, Huron, and Watertown substations.
Do	De-icing equipment for Fort Randall switchyard 230- and 115-kv. lines consisting of one 3,750-kva., one 1,500-kva., and one 500-kva. transformer, and switch assemblies.
Do	Furnishing and erecting control buildings and towers for radio communication facilities in South Dakota.
Ochoco, Oreg	Installing right abutment toe drain and spillway drain extension at Ochoco dam about 1 mile east of Prineville, Oreg.

United States Department of the Interior
Oscar L. Chapman, Secretary
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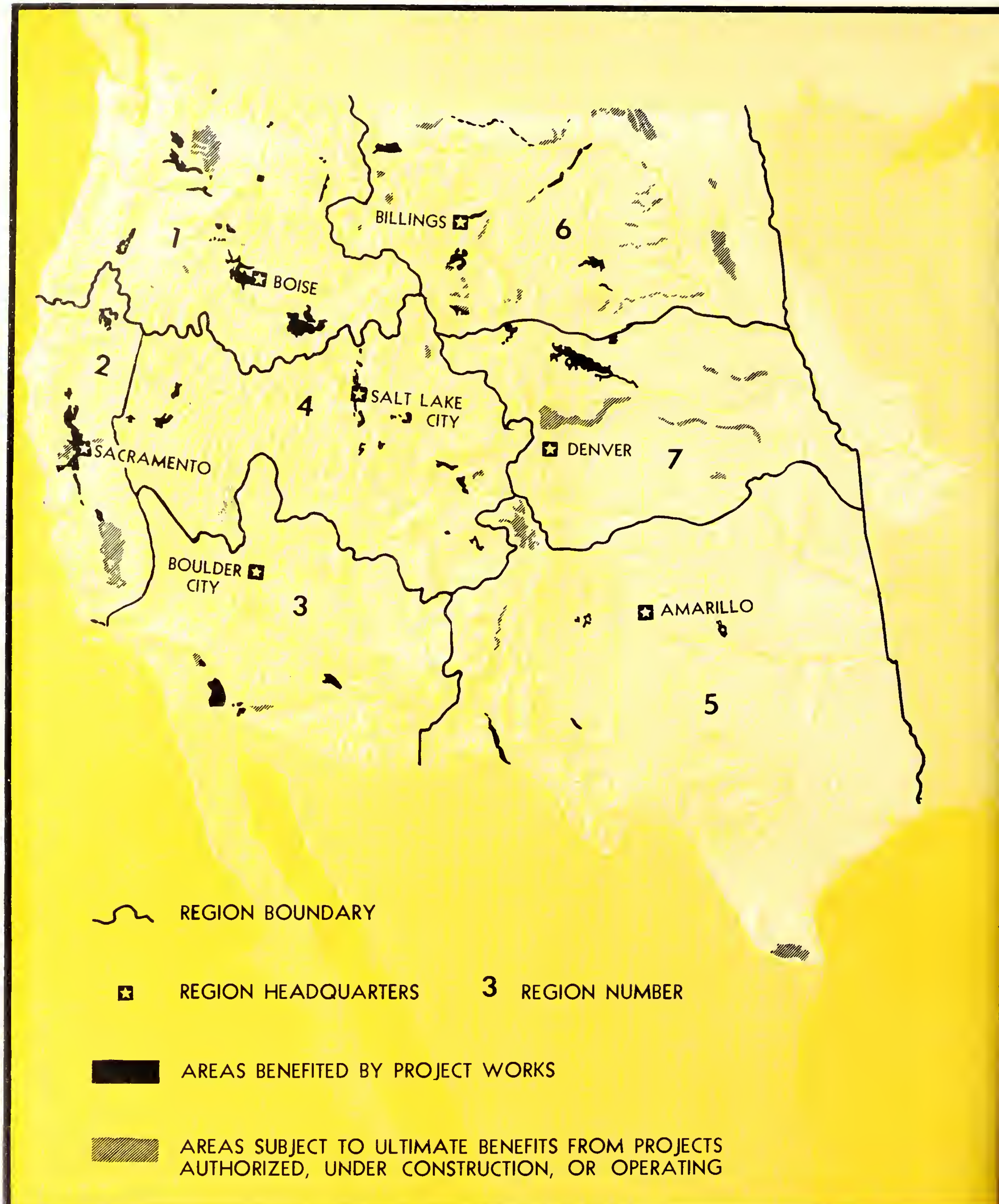
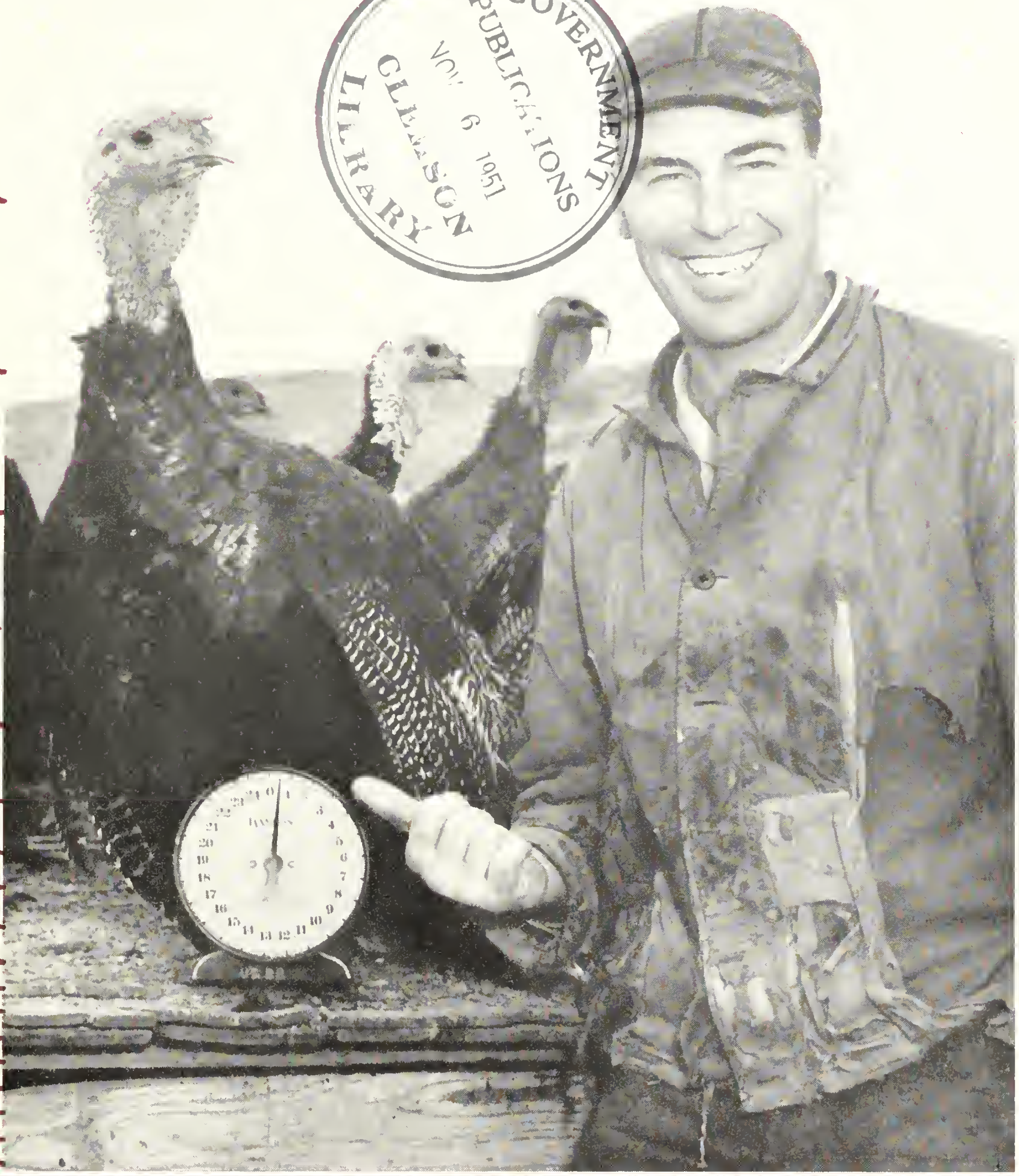


THE RECLAMATION AREA

The Reclamation ERA

November 1951



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Ruth F. Sadler, *Editor*

Subscription rate $1.50 a year for persons residing in the United States and Canada; $2 a year for foreign subscriptions; special rate of $1 a year for members of water users' associations, and Bureau of Reclamation employees.

OUR FRONT COVER

Symbol of Thanksgiving

Gillum and his 25½-pound gobbler seem rather proud of each other in this photo. At first glance the scales appear to denote the turkey weighs less than nothing. Another glance at the cover photo and the picture of the author of "Raising Turkeys in the Columbia Basin" on the opposite page reveals how a clever photographer can wring a turkey's neck to improve the picture. Photo by Harold E. Foss, Region 1 photographer.

30 YEARS AGO IN THE ERA

Those of us who are willing to admit a recollection dating so far back as 1902, when the reclamation act was passed, will remember the oft-expressed criticism by the lawmakers of the provision of the act which gave the Secretary of the Interior authority to turn over the management of a project to the water users. There were many who scoffed at the idea of letting a lot of farmers take over a $1,000,000 plant and run it. "Perfectly absurd," they said. "It can't be done."

Well, it can be and is being done today, and not a piffling million-dollar ditch system either, but a $14,000,000 corporation with huge power plants, inter-locking canals, pumping units, and everything. Housed in a magnificent office building, which is a credit to the enterprising city of Phoenix, the Salt River Valley Water Users' Association, the first to be formed under the irrigation law, is strictly on the job of managing one of the large irrigation systems in the United States and without a taint of politics.

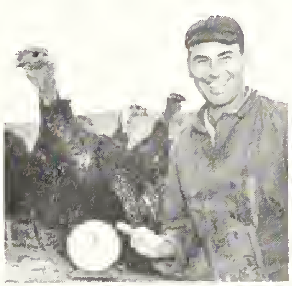
(From page 503 of the November 1921 issue of the RECLAMATION RECORD, predecessor to the RECLAMATION ERA.)

RECLAMATION PLACE NAMES IN THIS ISSUE

RAISING TURKEYS in the COLUMBIA BASIN

by OLDEN C. GILLUM

THE AUTHOR is a farmer on the Pasco pumping unit, the first land to receive water from the Columbia Basin project in the State of Washington. Water for this unit, near Pasco is pumped directly out of the Columbia River. *Photo by Harold E. Foss, Region 1 photographer, who also took the front cover picture—note the turkey's neck.*



One of the best places in the northwest to raise turkeys is the Columbia Basin. The small amount of rainfall during the summer and fall makes it ideal as turkeys do better on dry ground. The hot weather cuts down on disease spread. The climate is relatively mild well up into the winter—which is another good thing.

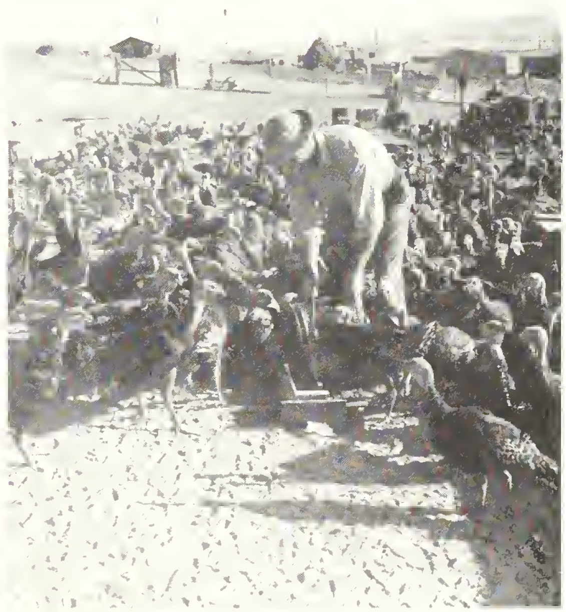
I started on my farm unit before there was water available for irrigation, so I put in wheat and raised a crop on the natural rain. I did not have too much to do until the crop was harvested so I raised turkeys. The year of 1948 was one of the best turkey years on record; consequently I did well. I did have my mother, father, and wife to help me the first two years, but the past two years the wife and I have done it alone.

Starting the poults is the biggest problem. The first thing is to get good stock, and then sleep with them for the first week. To eliminate trouble later we clip the last joint off one wing as we take them out of the box. This keeps them from flying later on. The next thing we do is to dip their beaks into water to help them to get started drinking and eating. One nearly always has to teach some of them to eat and drink.

We then put the poult under the brooder which has been running for two or three days to be sure it will hold to the right temperature for the young poults—95°, decreasing the temperature 5° each week until they are about five weeks old.

We use several tricks to help the poults to eat and drink. We start them on clabbered milk the first day. Then we fill the jars with water without washing them so the water will be cloudy.

CAUSE FOR THANKSGIVING—The Glen Eppich family (below) give thanks, not only for the turkey, and a good harvest from their Pasco unit of the Columbia Basin project. They are most thankful that little Lee, age 3, is again walking with the aid of a brace after being crippled by polio. The turkey on the Eppich table may have come from O. C. Gillum's flock (at right). *Photo below by H. E. Foss, photo at right by F. B. Pomeroy, both of Region 1.*



After that we wash the jars often. We spread the first feed out on white paper or egg case dividers. In short, one feeds the turkeys by their eyes and not their taste. Never change feed or even the placement of water or feed containers rapidly. Do it a little at a time. If they see anything new or different they will not like it. They must be afraid there might be a "booger man" in or around anything strange.

We soon found that there is a lot of work to raising turkeys and any labor-saving device was a big help. We built sun porches for the poults to run out on after they were 10 days old—but we kept the brooders going so the turkeys could run to the heat if they got cold. The sun porches gave them more space to run and kept a lot of the manure on the outside. We put feeders on the outside so they could be filled easily and we would not have to go among the poults. We have automatic float valves which keep the water containers full all of the time. Turkeys need plenty of fresh clean water.

We use a commercial feed, as it contains a better balanced feed than we could get together easily. Within the last few years Vitamin B-12 and by-products of medicines have been added. These make the poults grow faster and stay healthier. As a result we get more economical growth and lose less birds due to disease.

At from eight to ten weeks we put the turkeys on open range. It is good to have an acre to the hundred, but we have had 1,600 on 3 acres and they did well. Four things are necessary on this range. First, the ground must be dry, and disease free, and should have been cultivated or at least not had turkeys on it the previous year. Second, plenty of good water. Third, plenty of feed available. Fourth, plenty of shade, as turkeys will pile up and smother each other looking for shade. Roosts are desirable but not necessary. If you put a light over the roosting place, a lot of turkeys will avoid injuries, since a turkey is afraid of anything that he cannot see.

Before going on this range the poults are vaccinated for fowl pox and a portion of the upper beak is taken off. This is to keep them from pecking each other. A turkey seems to be somewhat of a cannibal and will peck his fellow turks.

You can raise the poults more economically if you have good pasture such as alfalfa to run them on. If this cannot be done easily, then put out bales of alfalfa if the turkeys are not debeaked, and hammered alfalfa if they are debeaked. They cannot eat alfalfa out of a bale if the debeaking has been done.

After the poult is three weeks old, success depends on keeping feed, water, and grit before him. We feed them commercial pellets which contain high protein, crystal grit, and grain. Oats are good, especially until the poults are well feathered as oats help feathering. Pin feathers on a dressed turkey knock down the grade. Other grains are also used. Some use wheat, but I prefer corn since I was raised in the corn belt.

GILLUM'S TURKEYS—Loudly objecting to the rumor they just heard—that they will grace tables in the Pacific Northwest come Thanksgiving this year. ***Photo by F. B. Pomeroy, Region 1 photographer.***

The turkey is marketed as a turkey fryer or as a mature bird. I prefer to sell the mature bird. We sell some to killing plants and dress and sell many locally. Seven months is the average time from day-old until the bird is sold. This gives us five months free from turkey care.

If you are thinking of going into raising turkeys, here are a few things you should know. A turkey is one of the smartest dumb birds ever seen. They are so dumb that they will actually starve to death rather than change feed or places rapidly, and yet they can out-smart a human in many ways. A turkey is a past master at ways of getting hurt or killed. If there were 100 ways of committing suicide known to humans, a turkey would find 110. Never leave a place in the fence or gates where he can catch his head. A turkey just naturally likes to stick his neck out to eat or look at something. If he gets his head caught he will just stand there and pull back till he dies. Remove everything that you think could possibly hurt a turkey and he will still find many more.

There are many turkey diseases and you have to be on the lookout for them all of the time. Blackhead is probably the worst. If a poult won't eat and looks droopy, it is time to look him over and perhaps remove him from the flock till you see what is the trouble. There is one other thing that a turkey raiser must look out for and that is the coyote—both varieties—the two-legged as well as the four-legged kind.

Raising turkeys is a crazy but fascinating game. I have had a lot of headaches but the money I've made on them sure helps. THE END.

Alaskan Survey Crew Rewarded for Courage

In mid-September Secretary of the Interior Oscar L. Chapman rewarded a team of six Reclamation survey men and one guide with either salary promotions or medals for ingenuity and courage they displayed the previous summer in the face of extreme danger during a survey party in search of a power dam site on the Susitna River in Alaska.

Those receiving salary promotions were Daryl L. Roberts and William Weber of Juneau along with Edwin Stewart of Palmer. These three are still in the employ of the Bureau. The others, no longer with the Bureau, who received silver medals and certificates of meritorious service from the Secretary, were Ada E. Jaskar and Harry Johnson of Juneau, Terrence L. Robbins of Palmer, and Frank Swanda, the guide, of Anchorage.

The men were shipwrecked as they passed the mouth of the Oshetna River, lost their boats and all their supplies and equipment, except that which they salvaged after safely reaching shore. Among their resourceful devices to survive the subarctic region, were fish hooks made out of paper clips. With these, plus rods and tackle improvised from willow poles, blasting wire and shipping tags, they caught 74 fish during their 6-day-long vigil, first using horseflies, then fish eyes and cut fish for bait. Despite their ordeal, they managed to obtain useful survey data on the area by the time they were rescued by an Air Force plane. •

Davis Dam Nears Completion

The last major contract in the building of Davis Dam and power plant was awarded on September 6, 1951, when Secretary of the Interior Oscar L. Chapman announced that the Grafe-Callahan Construction Co. of Los Angeles was the successful bidder for the job of completing the dam's spillway stilling basin.

Work is scheduled to begin by the 6th of October 1951 and should be completed in April 1953. The contract provides for completing the concrete basin structure, excavating a spillway outlet channel, and improving the channel of the Colorado River.

The stilling basin will control the force of waterflow at the spillway and thus insure safety to the dam and powerhouse, as well as prevent downstream damage in the event of an unusually heavy flood.

Davis Dam, located on the Colorado River near Kingman, Ariz., is one of the four key structures built by the Bureau of Reclamation for the control and multipurpose use of the downstream flow of the Colorado River. The others are Hoover, Parker, and Imperial Dams.

Besides producing power, Davis Dam also regulates the irregular water releases from the Hoover power plant for the benefit of irrigated areas downstream and will facilitate water deliveries beyond the boundary of the United States as required by the treaty with Mexico. •

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OR YOU'LL FLOOD YOUR CROP. This bean field near Newman, Calif., could have been saved through proper drainage.

don't waste water

by PROFESSOR F. J. VEIHMEYER,
College of Agriculture, Davis, Calif.

ALMOST EVERYONE PICTURES the construction of dams to impound water or some phase of watershed protection as a means of conserving water. Certainly any method which will hold the water in storage during the rainfall period for release later where it can be put to use is a direct measure of conservation. It is apparent that savings can be effected by cutting down evaporation and seepage losses in conveyance of water to the points of use. These enterprises generally require a community effort and the cooperation of State and Federal agencies.

When we consider that more than nine-tenths of all the water used in California is for irrigation, there is much that can be done by individual water users to conserve it. The efficiency of irrigation, which is defined as the difference in the amount of water applied to the land and that held in the soil within reach of the roots, is surprisingly low in many parts of the State. Many areas do not have efficiencies as high as 60 percent. The 40 percent which represents waste is lost by evaporation, run-off at the lower ends of the fields, or by percolation below the depths of the roots of the plants. Much of this waste can be eliminated by the proper preparation of the land. The regulation of the length of runs and the width of checks to conform with the size of streams available and the slope and infiltration capacity of the soil are means of cutting down some of the losses.

It cannot be expected, of course, to eliminate all losses because some are inevitable. For instance, evaporation takes place during the time the water is being applied so long as the surface of the soil and plants are wet. This loss may amount to as much as 1 inch in depth of water for each application. Conveyance losses can be reduced by lining ditches and installing concrete pipe systems. Where topography, soil, and kind of crops being grown are suitable, water may sometimes be conserved by sprinkler irrigation.

The statement that losses usually amount to about 40 percent of the water applied may seem surprisingly great. In many instances, it has been found to exceed 50 percent, that is to say, over half of the water is wasted. Most of the trouble in

MAKE EVERY DROP OF WATER COUNT. Above, a farmer places checks in the furrows .o hold back the water and make certain it penetrates properly to the root zones of the grapes he is raising near Fresno, Calif. At left, a Lompoc, Calif., farmer shows how he cuts down on evaporation and seepage losses. He is using portable pipes to irrigate a field which will be planted to carrots.

irrigated agriculture is the use of too much water rather than too little. The fact that excessive amounts of water are being used is illustrated by the recent report of one of the best California irrigation districts which states that over 100,000 acre-feet were pumped for drainage—and this is not the total amount of waste since all of the wasted water was not pumped. This is not intended to be a criticism since this district has ample water and its system is designed to supply large streams of water to irrigators with minimum expenditure of labor for application. It does, however, result in large seepage losses.

A series of events follow the rise of the water table close to the surface of the soil. It has been said that habitation under an irrigation ditch is not possible without natural or artificial drainage. This need not be true if irrigationists will follow good practices and rational schedules for applying water. Before discussing this in further detail, it should be pointed out that most of the water applied to the soil is taken from it by plant transpiration and only a small portion is evaporated directly from the soil surface. This evaporation takes place from a layer of surface soil which rarely exceeds 6 inches in depth. When the water table is raised close to the surface, however, the loss by evaporation increases very rapidly. For instance, with the water table 1 foot from the surface, the loss is almost equal to the evaporation from a free water surface. When water reaches the surface of the soil and evaporates, the salts it contains are left and the increased salinity may reach a concentration high enough to become destructive to plants and soils. Examples of the deterioration of irrigated areas due to the wasteful use of water with resulting rise of the water table close to the soil surface are common throughout the world.

One reason for the low efficiency in irrigation or, saying this in another way, the large waste of water involved in irrigation, is due to the belief that best conditions for the growth of plants occur when the soil moisture is kept at a high level. This

belief is not founded upon facts. Greater growth is not produced by frequent irrigations as compared to infrequent ones. Examples of the waste of water can be seen all over California. For instance, cotton frequently is irrigated 8 to 10 times. Sugar beets, tomatoes, alfalfa, and orchards are irrigated much more frequently than necessary.

The soil, in fact, may be considered as a reservoir for water. The amount that can be held in this reservoir is limited by the kind of soil, and each soil has a certain moisture content below which water cannot be taken from it. The interesting thing is that moisture is equally available to plants between the upper and lower limit and, furthermore, plant growth is not increased by maintenance of large amounts of water in the soil.

Our experiments in California show that for most deciduous orchards two or three irrigations are ample. For cotton, three applications usually will suffice to produce maximum yields. The savings on the 1,200,000 acres of this crop to be planted this year could be very great. Alfalfa need not be irrigated more than once between cuttings on soils with high water-holding capacities. If the irrigation schedule is laid out in accordance with the moisture properties of the soil and the depth of the rooting of the plants, certainly water can be conserved, if only enough water is applied to the soil to refill the soil reservoir when it is depleted. It is common observation that most farmers apply the same amount of water at each irrigation. If 40 to 50 percent of the water is lost each time, it is obvious that considerable savings can be obtained by reducing the number of irrigations. Indeed the irrigated area in California almost can be doubled without increasing the demand for water if this wasted water were conserved.

Some plants have characteristics which necessitate wasteful use of water. Experiments with lettuce in one of the coastal areas of California show that the maximum use of water by one crop amounts only to about 4 inches, while frequently some 3 to 4 feet of water are applied. Consequently it is usual to find standing water at a depth of about 5 feet in most of this area. Lettuce plants have sparse root systems, most of which are in the surface soil. In order to keep them provided with water, frequent applications may be necessary, since generally it is impractical to put on very light applications by surface means. Irrigated pastures are another example of crops which take large amounts of water. Usually the use of water for irrigated pastures may be two or more times that for alfalfa.

While domestic and industrial uses of water at the present time are very small compared to agricultural use, savings can be effected. Much of the water used in cities is for irrigation of lawns. Measurements have shown as much as 2 or 3 times more water is applied than is actually required. The increased use of evaporative coolers is another source of waste of water.

In the over-all consideration of water consumption, it should be kept in mind that industry and urban uses of water must go hand in hand with agricultural developments. Some attention, therefore, should be paid to the desirability of applying water to shallow soils and to soils of very low water-holding properties. Would it not be better to deny water to poor lands and to use it for domestic and industrial purposes if the total supply in a given area is not sufficient for all purposes?

Much of what has been said is to stimulate thought on the part of the water user toward the part he may play in conserving water. I believe that through education and demonstration, much can be accomplished to help individuals in eliminating excessive wastes of water, and it may not be overly optimistic to say that much more land can be irrigated with the same water supply we now have if the water is used in a rational way with efficient methods of application on well prepared lands. The End.

V. F. W. Searching for Ideal Veteran-Farmer

A Nation-wide search is under way by the Veterans of Foreign Wars to select the most worthy qualified veteran who will receive a $50,000 farm on the Columbia Basin reclamation project next spring.

The farm will be transformed from raw, sagebrush covered land into a going farm in one spectacular 24-hour operation as a part of the celebration the Columbia Basin Commission is planning next May in connection with the first delivery of water from the Grand Coulee equalizing reservoir.

Veterans are urged to contact their nearest local V. F. W. post for details of the search and to determine if they are eligible for consideration.

INHIBITING ALGAE IN ARIZONA (at left) by large-sized spray loaded with Rada. Below, masses of moss (see arrows) at Yuma's Boundary Pumping Plant being pulled up by weed hooks, before Rada made the job easier. *Photos by the author.*

RADA for ALGAE*

(*pronounced AL-jee)

by CURTIS BOWSER, Weed Specialist

Region 3 headquarters, Boulder City, Nev.

RADA, or Rosin Amine D Acetate, has saved thousands of dollars, by putting an end to algae, commonly called blanket moss, frog moss, pond scum, water net, or just plain moss.

Late in the summer of 1946 and during early spring of 1947, reddish-blue strands or thread-like filaments of a plant, identified as Compsopogon species, red algae of tropical or subtropical distribution, began collecting upon the trash racks at the Boundary Pumping Plant which is located at the terminal end of the Valley Division drainage system of the Yuma project in Arizona. At this point, drainage water from some 90 miles of interconnecting drains, which serve this 50,000 acre section of the project, is taken from the ditch and lifted several feet into Mexico for subsequent dilution and reuse. The quantity of plant material collecting was not considered serious, although two men were required to keep the intakes free when the pumps were operating. This condition persisted for several months each summer but with cool weather in the fall the quantity of material collecting slowly decreased.

Fresh water algae follows a definite cycle of growth, depending on the intensity and duration of sunlight and its attendant effect upon water temperature. The troublesome red algae in the Yuma drainage system responded as a summer annual, and again in early spring 1948 the filaments began collecting. The seriousness of the problem was realized during the summer months when two to five workmen were required each shift to keep the gratings free. The peak was reached in July when for a period of several days a labor force of fourteen men was detailed during the day shift to remove algae which collected in great quantities when the pumps were operated at capacity. During this peak period, up to 18 dump-truck loads of algae growth were removed during the day shift with lesser amounts during other periods when pumping was reduced.

In general appearance, the algae filaments floating in the water resembled miniature evergreen trees without symmetry or a central stem, as the strands or threads were branched and rebranched. These masses of vegetative material were not attached to the soil but would drift idly in the water, collecting upon snags or resting in ponded areas until such volume had developed that by sheer drag in the current the mass would tear loose to continue on its downstream course. Some filaments floated near the surface, and others with less buoyance, because of intertwined debris, rolled as a mass upon the bottom of the drain and as a result the trash racks were blanketed evenly with algae from top to bottom.

Consideration was given to every possible method to escape the high cost of labor required to clean the trash gratings. The laborers also

were interested in a more practical solution of removing the collecting filaments as it was no light task to wield a 14-foot-long weed hook, which often would bite into a greater quantity of debris than could be lifted. The installation of a mechanical trash remover was considered but to handle the volume of material in this large ditch would require a device of considerable size and elaborate design. Removing the trash gratings to allow the debris to pass through the pumps was believed practical until, on trial with one of the smaller pumps, it was shown that the long-clinging filaments would not pass through the bell casing but simply matted and twined about the impeller shaft. Installation of a nonclogging trash pump also was discussed. However, as with other weed problems, it appeared most logical to attack the problem at its source.

Treating the water with chemicals was considered and preliminary tests with the common algaecides were undertaken. Although these chemicals were toxic to the algae, use of the materials could not be recommended considering the quantity of water to be treated.

Research personnel in the weed-control laboratory of the Chief Engineer, Bureau of Reclamation, in cooperation with technicians of the Hercules Powder Company, reported that a primary amine derived from a specially modified rosin had proved to be a very active algaecide. This product under the trade name, Rosin Amine D Acetate (or RADA for short) does not possess any undesirable characteristics, is very inexpensive, and is marketed in a form ready to apply when mixed with water.

The first introduction of this new algaecide into the drains on the Yuma project during the early spring of 1949 was followed immediately by dragline operations in the drainage system. The resultant roiling of the water, combined with the chemical, deterred growth of algae during most of the season.

There was some question as to whether the turbid water or the chemical had suppressed the algae, but all doubt disappeared following re-treatment of the drainage system with RADA during the spring of 1950 at a period when the water was quite clear. At that time applications of RADA were made at rates of 10 parts per million for 15 minutes contact time at 2-mile intervals through the main stem of the drain. Effects of the chemical were apparent immediately as the quantity of algae collecting on the trash racks decreased appreciably. Although a huge quantity of debris still was being forked from the racks, the algae filaments were waterlogged and lifeless and did not possess the sheen or resilience of healthy vegetation. Several days later the labor force could be transferred to another activity. Thereafter, periodic cleaning of the grates, a routine practice several times each shift, was easily handled by the pump operators.

For trial testing it is suggested that 10 parts per million RADA for 10 minutes contact period be used, although this dosage may prove to be greatly in excess of the minimum amount required to destroy most algae in irrigation systems. The distances between introduction stations will of course depend largely upon water velocity and density of plant growth. In all probability, under favorable conditions the chemical will carry and be effective for many miles. No special equipment is required to make introductions of RADA—simply use similar equipment and apply in a manner comparable to that recommended for using aromatic solvents. This algaecide is not effective in suppressing rooted aquatic vegetation. (Use of chemicals to suppress submerged aquatic weeds in irrigation systems was discussed in the May 1948, and April and May 1950 issues of Reclamation Era.)

Rada Saves $2,200

Rosin Amine D Acetate may be a solution to your algae problem. Consider the one situation of the Yuma project Main Drain where chemical applications now are made each spring and fall as a routine practice in preventing a build-up of the algae population. The cost of hand labor to remove the plant growth during 1948 alone was in excess of $2,500. Positive relief from the undesirable plants was accomplished during the 1950 season through use of RADA at a total cost of only $300, a saving of $2,200. Previous time-consuming, back breaking hand labor cost more than eight times as much as the RADA treatment.

This is one of the many refinements in plant suppression techniques which are being realized through the program of coordinated research from the laboratory investigational stage of new products through to field applications bringing about more practical, time-saving and economical solutions to weed problems. The End.

WATER REPORT

by R. A. WORK, Senior Irrigation Engineer, and CLYDE E. HOUSTON, Irrigation Engineer, both of the Soil Conservation Service, United States Department of Agriculture.

Recent and widespread discussion in the national press has resulted from apparent differences of interpretation as to current status of western water supply, particularly stream flow in Columbia River Basin. The flow of this mighty river not only is used for irrigation and navigation but for generation of huge blocks of hydro-power by privately and publicly owned utilities. It is in direct connection with power generation that national interest is now sharply focused upon this river, since the productivity of certain vital industrial plants is dependent upon availability of large blocks of low-cost water power. The authors' purpose in thus briefly mentioning this Columbia River situation is merely to illustrate the growing importance to industry of dependable water supply. Now, actually, the flow of the Columbia at the time of this writing differs very little from what was anticipated several months ago. Readers of May 1951 Water Report will recall the then spotty outlook for western water supplies—generous water supplies in prospect for the Pacific Northwest ranging to drought conditions foreseen for Arizona, New Mexico, and southern Utah. As to the main Columbia itself, as gaged by its flow at The Dalles, Oreg., the early spring forecasts of 1951 were closely verified as follows:

Gaging station	Obtained [1] acre-feet	Forecast for April–September			
		Apr. 1		May 1	
		Acre-feet	Error percent	Acre-feet	Error percent
Columbia—The Dalles	109,901,000	110,000,000	0	108,000,000	2

[1] Data of stream flow are provided by U. S. Geological Survey: are preliminary only and subject to revision.

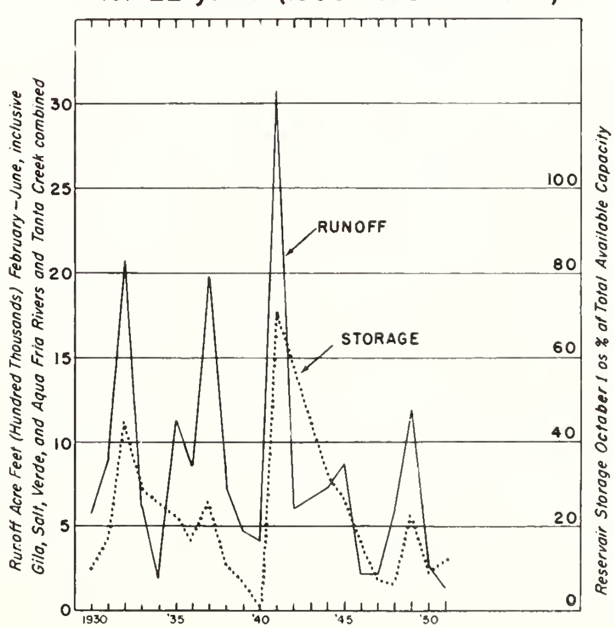
[1] The Division of Irrigation and Water Conservation is the Federal coordinating agency of snow surveys conducted by its staff and many cooperators, including the Bureau of Reclamation, other Federal bureaus, various departments of the several States, irrigation districts, and private agencies. The California State Division of Water Resources, which conducts the snow surveys in that State, contributed the California figures appearing in this article.

However, before turning to a general review of outcome of the forecasts for the season just concluded, a brief peek into the prospects for 1952 is of concern. In the following paragraphs, the Division of Irrigation and Water Conservation, Soil Conservation Service,[1] describes the results of its October 1 survey of the reservoir storage and soil moisture situations throughout the West and compares the 1951 run-off of western streams with that which was forecast from the April and May 1951 snow surveys.

So far as water held over in storage is concerned, the outlook is not uniform. Storage reserves are very poor through the Southwest, particularly in Arizona, New Mexico, and Texas, but improve to the north. Reserves are average or better in California, Nevada, Utah, and Washington, and range up to excellent in Idaho, Montana, and Wyoming.

The prolonged western dry spell of 1951, broken here and there by spotty above-normal rainfall, may unfavorably affect watershed soil priming. In such case, snowfall of average proportions in 1951–52 will produce run-off of less than average proportions next season. There still is time,

ARIZONA'S SURFACE WATER SUPPLY
for 22 years (1930—1951 inclusive)



through October and November, to receive heavy rains which will better prime the watersheds in advance of their winter snow blanket.

Here is a brief résumé of the storage situation:

ARIZONA.—During the past summer, reservoir storage dropped to less than 1 percent of capacity, but heavy rains in August brought it up to 12 percent. If greater than normal snowfall is not forthcoming this winter, the outlook for next summer will be for a critically short water supply.

CALIFORNIA.—As the opening of the rainy season is approached, California has in storage, in major Sierra reservoirs, a 4 percent smaller supply than carried forward at the same date last year. Thus, 25 reservoirs serving the Sacramento and San Joaquin held 4,380,260 acre-feet on September 30, 1951, or 55 percent of capacity as compared with 4,581,200 acre-feet and 58 percent of capacity on September 30, 1950. The 1951 storage is normal as compared to records for the 10-year (1940–49) period.

Watershed	Number of reservoirs	Capacity	Water stored Sept. 30	
			1950	1951
Sacramento	1	4, 366, 800	2, 702, 000	2, 431, 400
Feather	4	826, 800	632, 600	624, 580
Yuba	3	244, 800	153, 900	136, 260
Bear	1	7, 200	1, 700	2, 190
American	2	30, 200	19, 900	16, 260
Mokelumne	2	349, 000	271, 000	271, 120
Stanislaus	3	145, 500	32, 900	25, 430
Tuolumne	3	676, 800	356, 000	373, 860
Merced	1	281, 000	16, 900	17, 270
San Joaquin	5	854, 400	268, 400	355, 990
Total	25	7, 915, 700	4, 581, 200	4, 380, 260

COLORADO.—The outlook for next season in the South Platte Valley is improved over last fall since carry-over in irrigation reservoirs is slightly above average. On the west slope and in southern Colorado, the picture is not so bright as there is no carry-over storage in San Luis Valley. October 1 storage in 48 reservoirs in Colorado was 34 percent of capacity and the past 10 year average storage for that date was 40 percent of capacity.

IDAHO.—Carry-over storage is good. October 1 storage in Idaho reservoirs was 59 percent of capacity while the past 10-year average was only 32 percent. Average snowfall during the winter months should insure next season's irrigation water supplies.

MONTANA.—Reservoir storage for the Missouri and Columbia River Drainages in Montana is well above average. October 1 storage in 21 representative reservoirs is 75 percent of capacity and 25 percent greater than the past 10-year average.

NEVADA.—Reservoirs stored about 60 percent of capacity and greater than normal for the fall season. Highest storage is in the Sierra and lowest in the central and eastern portion of the State.

Reservoir	Capacity, acre-feet	Active storage Oct. 1	
		1951, acre-feet	1940–49 average, acre-feet
Wildhorse	32, 690	9, 483	10, 794
Rye Patch	179, 000	85, 300	116, 039
Bridgeport	42, 455	20, 113	16, 247
Topaz	59, 440	16, 918	18, 450
Lahontan	290, 900	110, 000	138, 281
Tahoe	732, 000	531, 600	408, 262
Boca	40, 900	27, 800	24, 597

NEW MEXICO.—Storage in the major reservoirs including El Vado and Elephant Butte approaches zero. Six major reservoirs with a total capacity of 3,629,800 acre-feet contained about 250,000 acre-feet on October 1. Last year at this time, these 6 reservoirs stored about 800,000 acre-feet. Unless mountain snow accumulation during the 1951–52 season is well above normal over the whole Rio Grande watershed, another year of severe water shortage may be expected.

OREGON.—Twenty-three reservoirs stored water at 35 percent of capacity on October 1 and at 85 percent of the past 10-year average. Greater than normal snowfall is needed during the coming winter to guarantee adequate irrigation water supplies for several sections of Oregon.

UTAH.—In northern Utah, October 1 storage is 61 percent of capacity, while in the central and southern part of the State, it is only 7 percent. For the State as a whole, storage as of the above date is 54 percent of capacity and nearly 25 percent above average.

Reservoir	Capacity, acre-feet	Oct. 1 storage, acre-feet	
		1951	1940–49 average
Bear Lake	1, 420, 000	1, 102, 200	766, 890
Deer Creek	147, 700	117, 700	70, 830
East Canyon	28, 730	12, 725	14, 755
Echo	73, 900	38, 400	20, 050
Hyrum	15, 300	5, 600	5, 090
Moon Lake	35, 800	11, 900	8, 480
Pineview	44, 200	13, 400	13, 820
Strawberry	270, 000	132, 700	68, 725
Utah Lake	850, 200	350, 900	343, 000
Otter Creek	52, 500	2, 080	23, 870
Piute	84, 750	1, 320	10, 700
Rocky Ford	23, 300	2, 490	9, 660
Sevier Bridge	236, 000	0	101, 370
Scofield	65, 800	26, 700	8, 950

WASHINGTON.—Washington is entering the snow season with reservoirs storing about 41 percent of capacity. This is comparable to the average stored supplies on this date for the past 10 years.

WYOMING.—In general, storage water in Wyoming reservoirs is above average. For 10 representative reservoirs, storage on October 1 was 69 percent of capacity and about 65 percent greater than the past 10-year average.

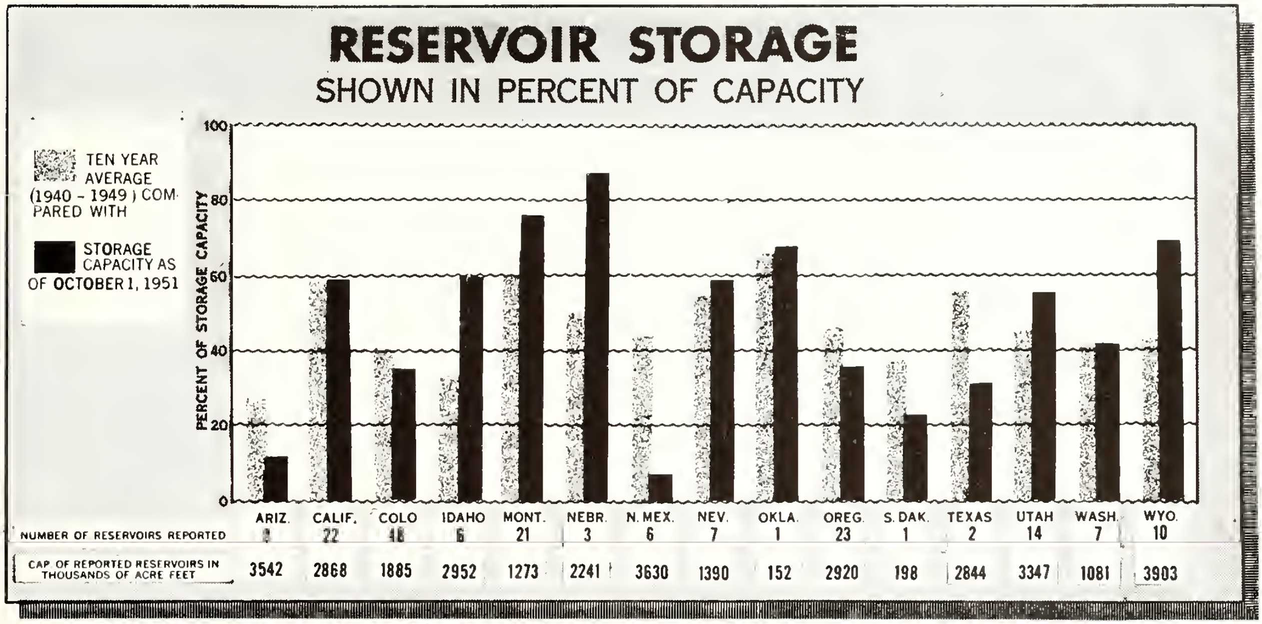
Accuracy of 1951 Run-off Forecasts

Departures of actual stream flow from the amounts forecast from April snow surveys were of greater than usual magnitude in certain regions in 1951 due to under- or over-estimation of the soil priming factor. At least, analysis of results seems to indicate this as the basic cause of error. The snow surveyors are now recasting their forecast formulas for certain basins in view of 1951's experience, and water users should correspondingly profit in future years through improved forecasts.

ARIZONA.—During the last week of August, a general storm occurred throughout most of the State. Up to 12 inches of rain fell on the watersheds in a 4-day period. Coming at a time when the State's total reservoir storage had dropped to a pitiful low of 8,000 acre-feet, this storm was providential. It brought about 350,000 acre-feet of water into thirsty reservoirs. While this storage was still only a fraction of capacity, it meant the difference between continued drought conditions and ability of farmers to plant fall vegetables and grain crops with some degree of security. Stream flow during August was above normal on all rivers. The Tonto ran over 1,700 percent normal. However, stream flow during all the summer months has been only about 50 percent of normal.

Soil moisture conditions on range lands and forests were improved by this storm. However, precipitation during September was below normal and temperatures above normal. Consequently, some watershed drying has since occurred. These rains also renewed life in some mountain springs but did not affect the ground water level under most of the pumped areas. Water tables are steadily dropping.

The chart on page 249 shows the October 1 residual



Most State averages are for full 10-year period, but in a few cases, reservoirs having shorter records are included.

CALIFORNIA—Does not include Millerton or Shasta Reservoirs. October 1 storage in these two reservoirs combined was 2,702,900 acre-feet or 54 percent of capacity. COLORADO—Does not include John Martin Reservoir. October 1 storage was 59,300 acre-feet or 9 percent of capacity. MONTANA—Does not include Fort Peck Reservoir. October 1 storage was 13,990,000 acre-feet or 74 percent of capacity. Does not include Flathead Lake with October 1 storage of 1,773,000 acre-feet or 99 percent of capacity. NEVADA—Does not include Lake Mead. Octobe r 1 storage was 19,118,000 acre-feet or 70 percent of capacity. WASHINGTON—Does not include Roosevelt Lake. October 1 storage was 5,220,000 or 100 percent of capacity.

storage for each year from 1930 through 1951 for the 8 principal irrigation reservoirs of Arizona. Also shown in the figure is the spring run-off combined for the principal streams used for irrigation. It is to be noted that residual storage October 1, 1951, is only 50 percent of average and 11.9 percent of capacity. Looking backward, only in 1940 and 1948 were October 1 storage reserves appreciably less than those of 1951. 1941 showed big spring run-off. 1949 showed fair spring run-off. Will 1952 spring run-off be sufficient to "bail" Arizona out? 1952 spring snow surveys will provide the answer.

The outcome of the Arizona forecasts in 1951 is shown below. The actual flows obtained exceeded forecast amounts because of early summer rains in mid-May.

Stream	Obtained[1] acre-feet	Forecast for February–June			
		March 1		Apr. 1	
		Acre-feet	Error, percent	Acre-feet	Error, percent
Gila	27,350	20,000	27	22,000	20
Agua Fria	0	0	0	0	0
Salt, Tonto, Verde	133,690	120,000	10	127,000	5

[1] Preliminary only, subject to revision.

CALIFORNIA.—On April 1, run-off from the Sierra snow pack was expected to be less than 65 percent of normal. Weather conditions during April slightly improved the May 1 over-all expectancy. However, run-off during April–July greatly exceeded that forecast either on April 1 or May 1. This was particularly true on the Kern and Kaweah watersheds where the April 1 forecasts pointed toward the smallest summer flows since the start of snow surveys in 1930. Although the forecast run-off was exceeded on each of these watersheds, flows for the period were still below normal.

The reason for the discrepancy of forecast flow from that obtained appears to be that sufficient consideration was not given to delayed run-off from the extremely heavy rainfall of November and December 1950. It is now indicated that rain which then fell resulted not alone in the extreme floods of that date, but also imparted an extremely heavy soil priming water charge to the soil mantle. This soil moisture later froze during the winter and when the spring temperatures rose, again started moving into the stream channels. This then accounted for a large percentage of the summer flow carried in the Sierra streams during the 1951 snow-melt period.

It will be noted in the tabulation below that the greatest accuracy of forecast was obtained on the extreme northern Sierra streams in the area not so affected by the heavy fall storms.

Gaging station	Obtained[1] acre-feet	Forecast for April–July, full natural flow			
		Apr. 1		May 1	
		Acre-feet	Error, percent	Acre-feet	Error, percent
Sacramento River into Shasta Reservoir[2]	1,474,200	1,500,000	2	1,350,000	8
Feather River near Oroville	1,500,500	1,500,000	0	1,400,000	7
Yuba River at Smartsville	890,200	775,000	13	725,000	19
American River at Fair Oaks	1,039,000	750,000	28	820,000	21
Mokelumne River near Mokelumne Hill	353,300	250,000	29	250,000	29
Stanislaus River below Melones	531,500	370,000	30	350,000	34
Tuolumne River at LaGrange	928,500	750,000	19	750,000	19
Merced River at Exchequer	453,800	325,000	28	350,000	23
San Joaquin River at Friant	920,400	725,000	21	750,000	19
Kings River at Piedra[2]	853,700	600,000	30	600,000	30
Kaweah River near Three Rivers[2]	171,500	65,000	62	90,000	48
Kern River near Bakersfield[2]	263,000	80,000	70	110,000	58

[1] Preliminary only, subject to revision.
[2] Impaired flows—not full natural flows.

COLORADO.—Irrigation water supplies in Colorado followed the pattern indicated by the snow accumulation last spring. In the South Platte Valley and on the Up-

(Please turn to page 260)

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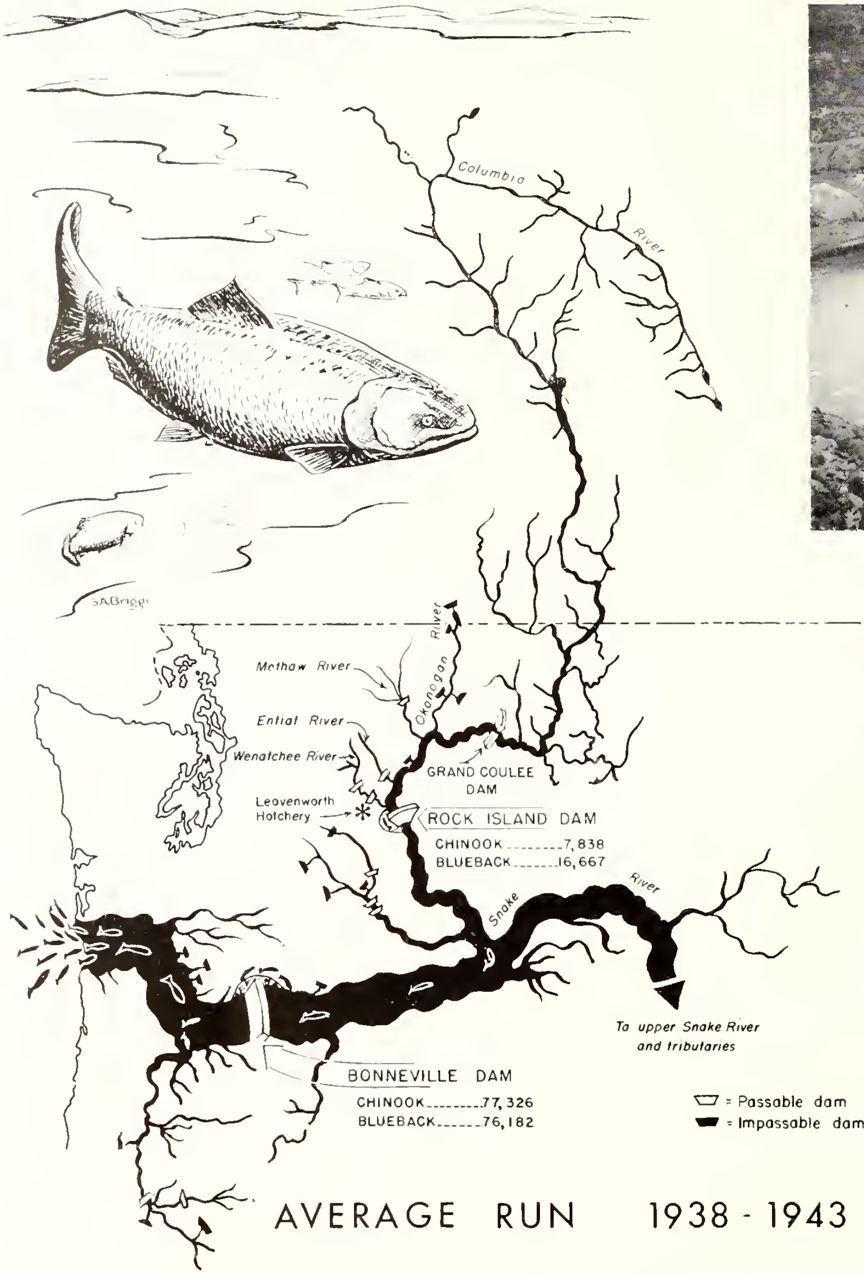
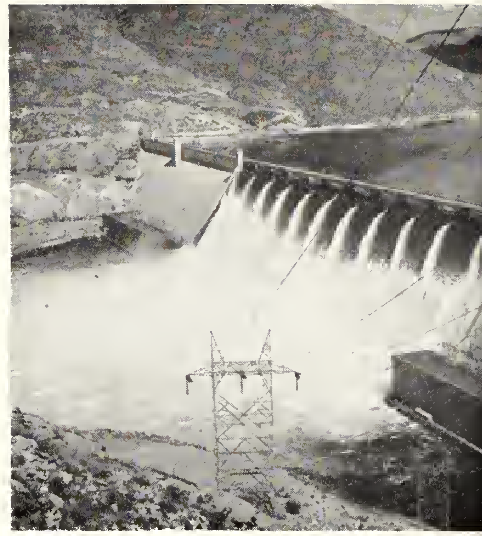
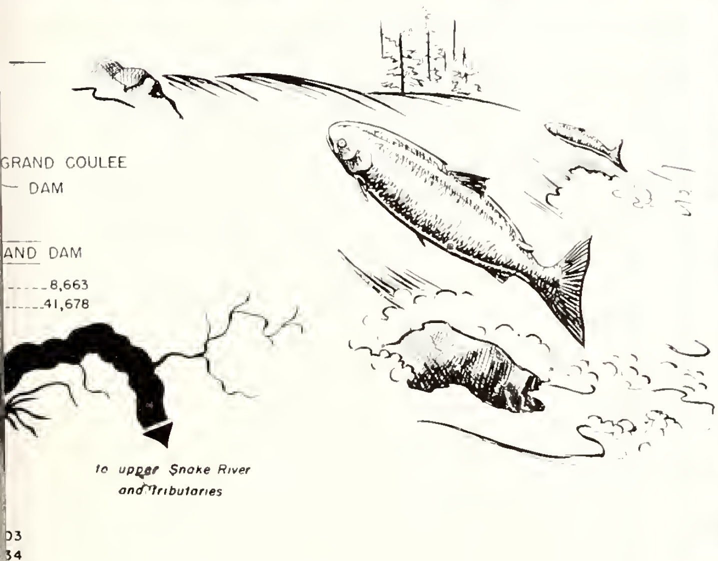




SALVAGING SALMON AT

by C. J. BURNER, Chief, North Pacific Fishery Investigations, Fish and Wildlife Service, Seattle, Wash.

The steel and concrete curtain that fell on the Columbia River salmon runs at Grand Coulee in 1939 marked "finis" to spawning areas where mating, egg-laying, and rearing had taken place for countless decades. A gigantic dam blocked the home streams of a portion of the salmon runs then worth 300,000 dollars a year and valued at considerably more now. With little more than the "Home Stream Theory" upon which to base their efforts, the U. S. Fish and Wildlife Service turned this unhappy picture into a successful experiment in salmon relocation. Here is how it was done.



AFTER FIVE YEARS' OF FREE RIDES salmon got used to new homes. Map at far left shows former spawning grounds north of Grand Coulee Dam. At immediate left, present restricted area. *Drawing by Shirley Briggs, Graphics Section.*

RAND COULEE

UNDER-STOCKED STREAMS below Grand Coulee Dam (top page 252) became new homes for displaced salmon. Trapped at Rock Island Dam, given an elevator ride and dumped into a fish-tank truck (top center), some were artificially spawned at the Leavenworth Hatchery (upper right) while others were hauled directly to their adopted "home stream" for natural propagation. At lower right, an employee in the Leavenworth Hatchery checks eggs.

Grand Coulee Dam, 550 feet high, was the culmination of years of planning by citizens of eastern Washington and the Bureau of Reclamation to build a dam across the Columbia and pump a portion of its run-off into the nearby Grand Coulee for purposes of irrigating the great expanses of

Fish Counts at Bonneville and Rock Islands Dams

CHINOOK [1]

	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	For years 1938–43	For years 1944–50	For years 1938–50
														average	*average*	*average*
Bonneville	42, 648	100, 155	88, 344	88, 718	65, 108	78, 984	43, 469	71, 135	118, 531	172, 422	108, 965	96, 806	106, 893	77, 326	102, 603	90, 937
Rock Island	5, 803	11, 206	9, 492	2, 571	6, 814	11, 145	3, 375	5, 696	9, 992	11, 766	7, 095	12, 350	10, 365	7, 838	8, 663	8, 282
Percent [2]	13. 6	11. 2	10. 7	2. 9	10. 5	14. 1	7. 8	8. 0	8. 4	6. 8	6. 5	12. 8	9. 7	10. 1	8. 4	9. 1

BLUEBACK

	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	For years 1938–43	For years 1944–50	For years 1938–50
Bonneville	75, 040	73, 382	148, 805	65, 745	55, 475	[3] 38,645	[3] 13,471	9, 501	74, 354	171, 139	131, 537	51, 444	77, 993	76, 182	75, 634	75, 887
Rock Island	17, 123	19, 591	28, 894	949	15, 782	17, 665	4, 932	7, 142	46, 563	79, 834	84, 627	18, 601	50, 047	16, 667	41, 678	30, 135
Percent [2]	22. 8	26. 7	19. 4	1. 4	28. 4	45. 6	36. 6	75. 2	62. 6	46. 6	64. 3	36. 2	64. 2	21. 9	55. 1	39. 7

[1] Bonneville counts are through July only. Few, if any, of the fall-run chinook migrate as far up the river as Rock Island.
[2] Percent Rock Island count is of Bonneville count.
[3] Does not include fish taken at Bonneville for artificial propagation.

fertile plains to the south, and at the same time to generate electricity at the dam.

In the burst of enthusiasm over this Northwest development, the salmon were nearly overlooked. The dam would isolate over 1,000 miles of spawning streams in the upper Columbia River. What to do with the displaced thousands of salmon ranging in weight from 2 pounds to over 50 pounds?

Because of Grand Coulee's height and fluctuating forebay, it was not considered practical to use fishways similar to those at Bonneville. In addition, there was no known method of preventing the small seaward migrating youngsters from getting killed by being swept down over the 350-foot chute-the-chute spillways.

In cooperation with several State agencies, the U. S. Fish and Wildlife Service (then the U. S. Bureau of Fisheries) proposed a plan to transplant the runs of "dammed" salmon into tributaries that enter the Columbia River below Grand Coulee. The plan was based on the theory that salmon will return to the stream in which they were hatched or planted as fingerlings. The idea was to trap the runs at a point below Grand Coulee Dam and transfer the adult fish to streams that would remain accessible. There were two reasons for deciding upon this solution: (1) All of the fish which normally spawned above the Grand Coulee Dam could be stopped and trapped at Rock Island Dam, about 150 miles downstream from Grand Coulee. (2) Suitable tributaries into which the displaced salmon could be relocated were available in the Wenatchee, Entiat, Methow, and Okanogan Rivers. These mountain streams contained excellent spawning gravels and the runs frequenting them were badly depleted. In addition to the natural spawning area in these streams, the largest fish hatchery in the world was provided by the Bureau of Reclamation, together with a system of smaller hatcheries, to augment the salmon production.

Construction work began at Grand Coluee in 1933; but the dam did not become a barrier to salmon until 1939. In that year as the salmon migrated upstream, they were trapped at Rock Island Dam and hauled in 1,000-gallon tank trucks to the selected streams for natural propagation. Some were also hauled to the large Leavenworth hatchery for artificial propagation. These trapping and transporting operations were continued each year until the termination of the 1943 migration, a period of five years. This is long enough to cover the life-cycle of the salmon, which ranges from three to six years—most of them are four and five years old with very few returning in their sixth year.

The plan was to trap and haul the fish for five years and then to remove the traps at Rock Island Dam and let the salmon proceed upstream on their own power, without benefit of tank truck pullmans. Here was an opportunity to test the Home Stream Theory on a grand scale. Would these full grown offspring of the transplanted salmon return to the streams where they were hatched and reared, or would they attempt to migrate on upstream to the old spawning grounds above the dam? 1944 was the first year that the returns from these stocks were permitted to pass Rock Island. Fishery biologists waited anxiously and watched the salmon proceed upstream, mile upon mile. Finally the fish turned in to the new streams

and disregarded the open river up which their ancestors had proceeded for so many years! The plan worked! The home stream theory held true.

Data obtained since 1944 indicate that the program has been an unqualified success. In that year 8,307 salmon passed Rock Island Dam and only 6 were seen below Grand Coulee Dam. Because these latter were large chinooks, it is possible that they were 6-year old fish of the 1938 brood which were not relocated by the salvage program.

The real success of the Grand Coulee fish maintenance project in maintaining these runs in the upper Columbia River can be gaged by analyzing the number of fish which return over a period of several years. The Columbia River runs have fluctuated greatly from year to year, and the true measure of the project's success is the proportionate contribution of these upriver runs to the total runs into the Columbia River. Such a measure may be obtained by comparing the counts of fish at Rock Island Dam with the counts of fish passing Bonneville Dam. Data for the past 13 years are shown in the accompanying table.

Only an insignificant part of the runs of the large and valuable chinook salmon passing Bonneville Dam after July 31 proceed as far upstream as Rock Island Dam. Thus in the table, the Bonneville counts of chinook through July only are listed. Since chinook salmon have mostly a 4-and-5-year life cycle, the upriver run in 1944 was the first to consist entirely of transplanted stock. For the first 6 years (1938–43) the counts of the upriver runs of chinook have comprised from 2.9 percent to 14.1 percent of the comparable escapement (number of fish in the spawning run which escape) at Bonneville with an average of 10.1 percent. From 1944 to 1950, when the transplanted chinook were on their own, this ratio has varied from 6.5 percent to 12.8 percent with an average of 8.4 percent. Thus it would appear that these ratios are somewhat below the average for the years previous to the Grand Coulee program.

The blueback salmon present a different kind of story. These are the second most important species in the salvage operations. In the years 1938–43 the blueback averaged 21.9 percent of the Bonneville count and in the years 1944 to 1950 they show a surprising 55.1 percent for an increase considerably above the average.

Species of anadromous fishes (those which return from the sea to spawn in fresh water streams) other than chinook and blueback salmon are relatively unimportant in the Grand Coulee area. Silver salmon, once numerous, have an average count of 69 per year for the past 13 years. Steelhead trout runs have averaged approximately 2,700 fish per year for the same period. In 1938 the Rock Island steelhead count was 2,400; in 1944 it was 1,329, and in 1950 there were 1,840 counted at the dam. The years in between show wide fluctuations.

Thus it would appear that the Grand Coulee fish maintenance project is an outstanding, successful experiment in salvaging salmon runs. The "home streams" of thousands of commercially valuable salmon and trout were changed. The analysis of the data in the accompanying table clearly indicate that the ratio of Rock Island counts to the comparable Bonneville count is favorable for blueback salmon. The chinook salmon have more than "held their own" with some fluctuation in abundance. THE END.

Reclamation Aids Fish and Wildlife

"More and more, all over the West, people are finding that in actual practice, fish and wildlife improvement is prominent among the positive benefits of the Reclamation program."

This is an excerpt from Reclamation Commissioner Michael W. Straus' official policy statement read by planning engineer Vaud E. Larson at the conference of the Western Association of Game and Fish Commissioners held in Phoenix, Ariz., on April 30, 1951.

The statement urged positive action for the development of the Nation's fish and wildlife resources, pointing out that provisions for preservation of fish and wildlife on Reclamation projects had been a fundamental Bureau policy for more than 49 years, and that methods of protection were incorporated in project plans after consultation with conservationists. In his statement, Commissioner Straus asserted, "There need be no conflict between common-sense irrigation and fish and wildlife development if both will plan and both will work on the basis of the greatest good for the greatest number. Reclamation has supported and does support fish and wildlife development. State organizations and local irrigation districts, I believe, should do likewise. But the way to do this when water development is involved is not to fight to hold back Reclamation proposals but to push forward fish and wildlife proposals." •

Short Cuts to Weed Killing Calculations

Part 6.—Preparing Weed-Killing Solutions with Liquid

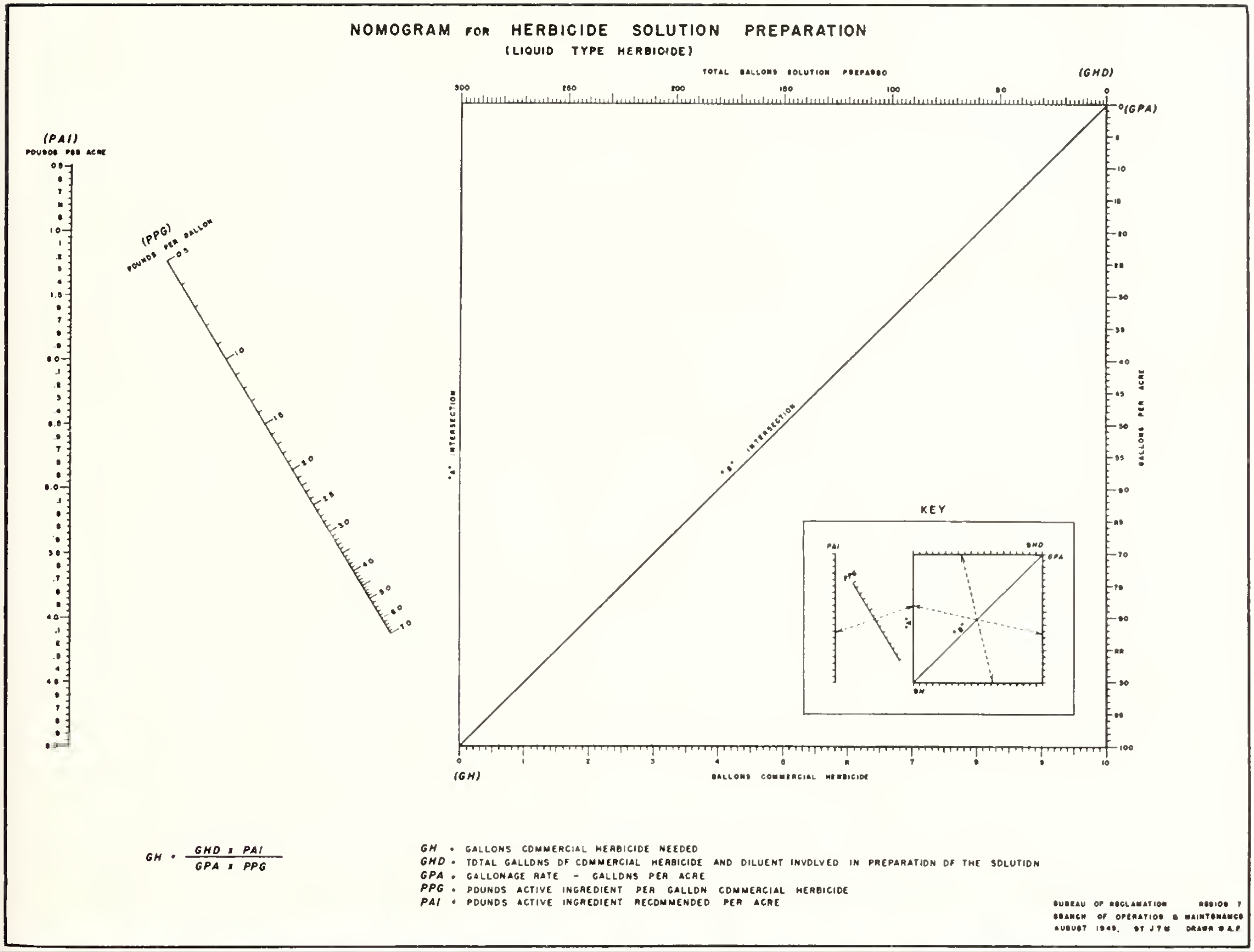
by **JOHN T. MALETIC**

Soil Scientist and Weed Specialist
Region 7 headquarters, Denver, Colo.

You can save money fighting weeds by making several simple calculations. Suppose you want to put a specified amount of weed killer on an acre, how do you go about putting on the specified amount—no less and no more? First, you must calibrate the spray rig so that at a given speed the rig puts out the exact gallonage you want on each acre (see the September issue of the Reclamation Era). Secondly, you mix the spray solution so that each gallon of the solution has just the right proportion of water and chemical. For example, suppose you wanted to put on 1 pound of 2,4-D acid on an acre of weeds. If the spray rig were calibrated to deliver 20 gallons per acre, then every 20 gallons in the spray tank would have to contain 1 pound of 2,4-D acid. If the weed killer you use contains inert ingredients and if it is in the liquid form, this must be taken into account when figuring the proportion of water and chemical to use. The nomogram on the opposite page will do the calculating for you—here then are the simple steps in preparing a spray solution with a liquid weed killer:

(1) Determine the number of gallons you want to put on each acre—this is the "gallonage rate" on the GPA scale, and should be determined when the rig is calibrated; (2) Decide upon the total gallons of spray solution (on GHD scale) you need this should be noted by marking the level of the tank or using a dip stick with a marker; (3) Decide on the best chemical application rate—that is, the pounds of active ingredient in the weed killer needed per acre—this is on the PAI scale; (4) From the label on the weed killer, read off the pounds of active ingredients in each gallon for the PPG scale. Knowing these four values, find the gallons of weed killer chemical needed by (a) connecting pounds per acre (PAI) with pounds per gallon (PPG) using a transparent straight edge and marking the point at which the straight edge crosses the "A" intersection; (b) connect the "A" intersection with the gallons per acre (GPA) and find a point on the "B" intersection; (c) finally connect the intersection point of "B" with total gallons of solution being prepared (GHD). Read the answer on the gallons commercial herbicide (GH) scale. This manner of connecting the scale is shown in the key in the diagram.

For example, a weed killer containing 3 pounds of active ingredients per gallon is to be applied at the rate of 2 pounds per acre by a spray rig calibrated to deliver 40 gallons per acre. If 250 gallons of solution are needed, how many gallons of weed killer should be placed in the tank? Con-

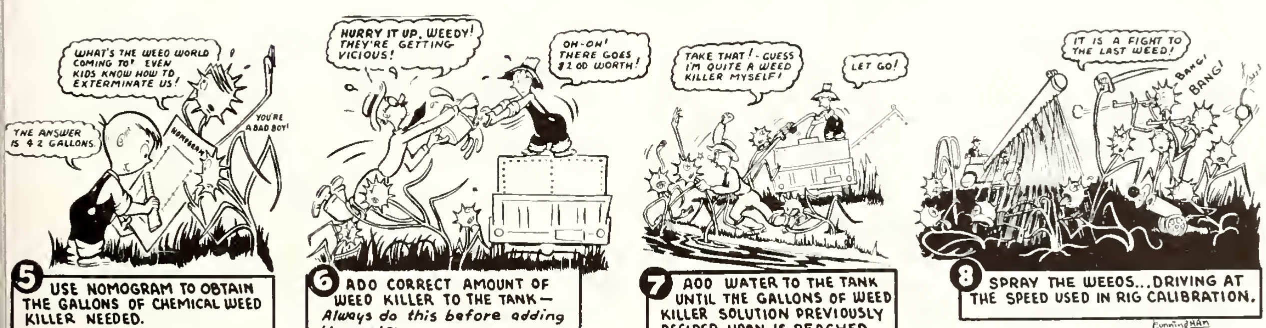


nect 3 on PPG (pounds per gallon) with 2 on PAI (pounds per acre); connect "A" intersection with 40 on GPA (gallons per acre); connect B intersection with 250 on GHD (gallons solution) and you have your answer—4.2 gallons on GH (gallons herbicide).

Now, add the 4.2 gallons of weed killer to the tank first, then fill with water until you have 250 gallons of solution. The weed killer is now prepared, but to make sure that the right amount is applied to each acre, drive the spray rig at the speed for which it was calibrated.

Next month: Part 7—How to Prepare Weed Killers for Woody Plants.

Reprints of this series are available upon request of the Commissioner or your nearest Regional Director. See inside back cover of this issue for addresses.



NEW CHECK for FARM DITCHES

by MARVIN N. SHEARER, County Extension Agent (Soils and Irrigation), Oregon State College, Madras, Oreg., United States Department of Agriculture and Jefferson County cooperating.

On some irrigation farms, permanent check structures are necessary and desirable. They hold back the flow of the water for proper application at the right place and time, they prevent erosion, make possible the irrigation of sloping lands and have many other advantages.

But when the time comes to clean weeds and silt and debris out of the ditches, these bulkheads become bug-a-boos, nuisances and obstructions. The only way to do the job properly is by hand—a messy, tedious and tiresome undertaking. But things are different out at the Jay Macy farm on the North Unit of the Deschutes project in Jefferson County, Oreg. This year Macy has permanent check structures and an easy cleaning job, too. As a matter of fact, the cleaning equipment can pass right through the checks without injuring them.

The secret lies in the removable panel which houses the check boards. This small redwood dam can be lifted easily out of its base making it possible to remove the entire obstruction from wall to wall. Once it is out of the way a chattin or similar type ditcher can run through the check and the entire length of ditch to be cleaned.

The concrete structure which holds the panel in place is basically a reinforced concrete ditch lining 4 inches thick and 4 feet long, with a headwall, containing bolts for holding the panel in place, and tailor-made grooves to insure a perfect fit. The bolts in the concrete work must be placed so they will not damage tractor tires during cleaning operations. As shown in figure 5, the permanent portion of this check takes the shape of the

BUILDING THE BASIN. Fig. 1, cut an 8" headwall into the bank, place the form in position and cut ditch bank back 4" to provide bed for concrete. Fig. 2, dump concrete into ditch form to fill headwall. Fig. 3, work the form into position. Fig. 4, use a shovel and trowel to shape the sidewalls of the basin.

ditch itself, and is reinforced with welded wire mesh. The minimum recommended width of the basin floor is 18 inches for ditches carrying 1½ second-feet of water, and 24 inches for ditches carrying up to 3 second-feet of water. The sloping sides make the check "ride the ground" during freezing winter temperatures. They lift the entire structure when the ground heaves and lower it when it thaws.

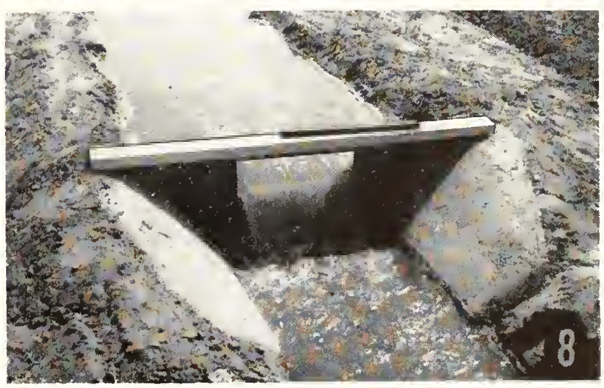
The panel is made of 1-inch redwood, put together as shown in figure 6. The check guide boards are bolted or nailed with galvanized nails to the panel walls, thus serving a dual purpose of holding the panel together and furnishing grooves for inserting the check boards as demonstrated in figure 7. As can be seen in these photos, the square opening in the panel is no wider than the bottom of the stilling basin. This is necessary to keep to a minimum any turbulence around the lower side of the structure.

The Jefferson County Extension Office developed plans for this check during the past 2 years, and when Jay Macy was in our office this spring he became so interested he immediately installed 14 of them. This is how much the job cost for material and labor:

2½ man-hours at \$1.25 per hour	\$3.13
1½ sacks cement at \$1.35 per sack	2.03
0.15 cubic yard sand at \$5 a cubic yard	.75
0.20 cubic yard gravel at \$5 a cubic yard	1.00
7 board feet redwood at \$125 per M	.88
Hardware	.25
Total cost of check	8.04

After making a set of 3 forms, Macy's crew of 2 men installed one check every 45 minutes. The concrete was allowed to set 1½ hours, then the forms were removed and reused.

After using his checks for 2 months, Macy had this to say about them, "The initial cost of these structures is not materially more than the temporary wooden ones previously installed. What is more, I am not bothered with mice damage, washouts, and leaks. This is as good a structure as I have ever checked water with in my 20 years of irrigation farming. The feature of being able to pull a ditcher thru the structure when I clean weeds and silt from my ditch has really made ditch cleaning a pleasure." THE END.



PUTTING IN THE PANEL. Fig. 5, the permanent concrete base should look like this when finished. Fig. 6, lower the panel into the groove provided in the concrete. Fig. 7, adjust the check boards in the grooves of the check guide boards, at whatever height you need. Fig. 8, the finished check in operation.

WATER REPORT

(Continued from page 251)

per Colorado River watershed water supplies were adequate. There was some shortage on the Arkansas and Gunnison River watersheds. An extreme deficiency in water supply existed on the Rio Grande and San Juan Rivers. On these latter watersheds, the general water supply was as little as at any time in recent irrigation history. This was due to the extreme shortage of snow cover during last winter and also in lesser part to the lack of precipitation during the irrigation season.

The summer flow of the Colorado River and all of its tributaries in Colorado was somewhat less than was indicated by the snow cover last spring. This was due largely to an extreme deficiency in precipitation in mountain areas during the late fall and early winter months of 1950. Water supply was adequate on the upper Colorado, White, and Yampa Rivers and on projects served by the upper Gunnison River. On the lower Gunnison River near Delta and Grand Junction there was a shortage of late irrigation water.

On the Rio Grande main stem, there was an extreme water shortage which was temporarily and partially alleviated by an increase in the amount of pumping. On some of the tributary streams to the east of the Valley, crop curtailment was almost complete. In this area, there is little opportunity for groundwater development. The water supply ranged from 10 to 25 percent of normal.

Gaging station	Obtained [1] acre-feet	Forecast for April–September			
		Apr. 1		May 1	
		Acre-feet	Error, percent	Acre-feet	Error, percent
Rio Grande at Del Norte	254,000	325,000	28	325,000	28
Conejos at Mogote	107,000	140,000	31	150,000	40
Animas at Durango	263,000	325,000	24	325,000	24
Roaring Fork at Glenwood Springs	750,000	950,000	27	900,000	20
Uncompahgre at Colona	71,000	125,000	76	125,000	76
Gunnison at Iola	777,000	700,000	10	700,000	10
Colorado near Grand Canyon	7,100,000	9,200,000	30	9,200,000	30
Poudre at Canyon	301,000	275,000	9	300,000	0

[1] Preliminary only, subject to revision.

IDAHO.—In general, the forecasts from snow water were for the above normal run-off which occurred on all major rivers. Heavy fall precipitation in Idaho during 1950 had a significant effect on the flow of the rivers in the spring of 1951. The soil was well primed on all rivers for the production of run-off from the normal or better snow cover. However, the unusual pattern of spring precipitation had its effect on flows because it was well above average on some streams and well below on others. Precipitation on the Kootenai River watershed was almost 3 inches above average for the period April through June, while that on the Clearwater was almost 2 inches below.

This year early precipitation over most of Idaho has been well below normal. This deficiency, if continued through October, will diminish the snow water yield for 1952. If snowfall during the coming winter is also below normal, run-off for 1952 will undoubtedly be well below that of the past 5 years.

Gaging station	Obtained [1] acre-feet	Forecast for April–September			
		Apr. 1		May 1	
		Acre-feet	Error, percent	Acre-feet	Error, percent
Kootenai at Leonia	10,813,000	10,000,000	8	9,200,000	15
Clearwater at Spaulding	8,310,000	8,800,000	6	8,800,000	6
Boise above Diversion	1,992,000	1,800,000	10	1,800,000	10
Salmon at Whitebird	7,726,000	9,000,000	16	8,000,000	4

[1] Preliminary only, subject to revision.

MONTANA.—The irrigation water supply for 1951 was adequate until early August. Due to below average precipitation during the summer months, the water supply dropped sharply during August and some shortages were then noted in areas lacking reservoir storage.

Gaging station	Obtained [1] acre-feet	Forecast May–September			
		Apr. 1		May 1	
		Acre-feet	Error, percent	Acre-feet	Error, percent
Judith River near Utica	39,900	30,580	23	30,580	23
Yellowstone River at Corwin Springs	2,159,000	1,770,000	18	1,770,000	18
Flathead River at Columbia Falls	7,224,000	7,200,000	0	7,200,000	0

[1] Preliminary only, subject to revision.

NEVADA.—The 1951 forecast for irrigation season stream flow varied from drought conditions in central and southern Nevada to about 50 percent above normal in the north on the main Humboldt. Snowmelt run-off from the eastern Sierra-Nevada was forecast from 25 to 50 percent of normal. Preliminary stream flow measurements indicate the Humboldt forecasts were high and the Sierra forecasts were low. The drought in central and southern Nevada continues unabated. Climatological data at 5 representative stations in the Upper Humboldt Basin show that during April, May, and June, average temperature was about 3 degrees below normal. This had a retarding effect on the melting of snow at high elevations. In fact, snow is still stored in drifts at high elevations and will probably remain there until next run-off season. It appears that the error in the Sierra forecasts is due to giving insufficient weight to the 350 percent normal precipitation which occurred during the storms of last November and December.

Gaging station	Obtained [1] acre-feet	Forecast for April–July	
		Apr. 1	
		Acre-feet	Error, percent
Humboldt River at Palisade	189,660	300,000	58
West Walker near Coleville	141,950	100,000	30

[1] Preliminary only, subject to revision.

NEW MEXICO.—The irrigation water supply in New Mexico this year was probably the poorest of record. Flow of the Rio Grande and its tributaries ranged from 5 to 20 percent of normal. Precipitation has been deficient for the past 2 or more years. Very little storage water was available and this was exhausted early in the season. Unless the snow accumulation during the 1951–52 season is well above normal over the whole Rio Grande watershed, another year of water shortage may be expected.

Gaging station	Obtained [1] acre-feet	Forecast for April–September			
		Apr. 1		May 1	
		Acre-feet	Error, percent	Acre-feet	Error, percent
Rio Grande at Otowi Bridge	190,000	175,000	8	225,000	18
Rio Grande at San Marcial	50,000	50,000	0	75,000	50

[1] Preliminary only, subject to revision.

OREGON.—Oregon precipitation during April–September fell far below average. Exact figures are not available, but indications are that the drought was relatively more severe west of the Cascade Mountains. Practically no provisional data of stream flow are available as of this date, but it is believed that smaller flows were obtained than were forecast. This was due to the summer drought. In general, the watersheds of highest elevations and good snow pack provided sufficient water supplies. Most smaller drainages with low watersheds showed early shortages of water for irrigation.

Gaging station	Obtained[1] acre-feet	Forecast for April–September			
		Apr. 1		May 1	
		Acre-feet	Error, percent	Acre-feet	Error, percent
Upper Klamath Lake inflow	588, 500	370, 000	37	540, 000	8

[1] Preliminary only, subject to revision.

SOUTH DAKOTA.—The irrigation water supply in the Black Hills area of South Dakota was below normal for this past year. Soil moisture and crop conditions are now reported as good due to precipitation during the late summer and fall.

UTAH.—The April 1 forecast was for water supply varying from excellent on the Cache and Wasatch forests in northern Utah to poor in Eastern Utah on Ashley Creek and severe drought in southern Utah. Although this general run-off pattern followed, above average April-May precipitation was responsible for stream flow greater than indicated in the forecast.

In southern Utah on Beaver River, the Beaver City precipitation station reports 180 percent of normal precipitation for the April–May period, accounting for the extra run-off here. In general throughout southern Utah, observers report that although more springs have dried up this year than usual, fall rains have left the surface soils of both watersheds and cropped lands in an average or better condition, preparatory for the coming snow accumulation season.

Gaging station	Obtained[1] acre-feet	Forecast for April–September	
		Apr. 1	
		Acre-feet	Error, percent
Bear River at Harer, Idaho	408, 000	295, 000	28
Big Cottonwood Creek near S. L. C.	41, 100	39, 000	5
Blacksmith Fork near Hyrum	92, 900	67, 500	37
Little Bear River near Paradise	51, 800	45, 000	13
South Fork Ogden River near Huntsville	94, 900	77, 000	19
Weber River near Oakley	147, 800	145, 000	2
Ashley Creek near Vernal	48, 600	42, 000	14
Duchesne River near Tabiona	140, 800	118, 000	16
Huntington Creek near Huntington	56, 600	40, 000	29
Beaver River near Beaver	18, 100	13, 500	25
Sevier River at Hatch	22, 700	22, 000	3

[1] Preliminary only, subject to revision.

WASHINGTON.—Relatively high flow of the major rivers in Washington as forecast from snow data occurred with very little change due to spring precipitation departures.

Snow water stored in 1951 at high elevation was proportionately greater in relation to low level snow cover than normal. This condition resulted in sustained flows on the Columbia River and many tributaries. Fall precipitation in Washington during 1950 was well above normal, which also may have helped to sustain the flow of the rivers.

WYOMING.—Irrigation water supply for the State of Wyoming was generally adequate for the 1951 season. Discharge of the North Platte, Laramie, and Green Rivers was above normal.

In general, that portion of Wyoming contributing to the flow of the Snake River produced greater than average stream flow. Some damage occurred along the Snake River in Wyoming as a result of the snow-melt flood which was partially controlled by dikes and regulation of water in Jackson Lake.

Gaging station	Obtained[1] acre-feet	Forecast for April–September			
		Apr. 1		May 1	
		Acre-feet	Error, percent	Acre-feet	Error, percent
North Platte at Saratoga	756, 000	725, 000	4	750, 000	1

[1] Preliminary only, subject to revision.

Shadehill Dam Completed in Record Time

Secretary of the Interior Oscar L. Chapman on September 6 announced the completion of construction on the Shadehill Dam in South Dakota in 85 percent of the initial time allotted for this work.

Shadehill Dam is a key feature of the Grand Division of the Missouri River Basin project and will provide irrigation water for 9,000 acres in Perkins and Corson Counties, S. Dak. It will also provide flood and silt control for the Grand River and materially reduce the amount of silt being carried into the Oahe Reservoir on the Missouri River.

The rolled earth-fill structure consists of the main dam, approximately 1,800 feet long and 120 feet high and a dyke which is 11,000 feet long and 30 feet high. The total volume of both is 3,500,000 cubic yards.

It is hoped to have the entire development completed to permit irrigation by 1954. •

Delegates Meet for 20th Annual NRA Convention at Amarillo, Texas

At the 20th Annual National Reclamation Association Convention held at Amarillo, Tex., October 17–19, 1951, the delegates passed a total of 38 resolutions, reaffirming opposition to Valley authorities, and supporting coordinated basin-wide planning and development. The Association favored continued construction of projects "necessary to keep the nation economically strong and adequately to serve the increasing demands and requirements of national defense," also urging that priority be given to power development for irrigation pumping.

Officers elected for the coming year included C. Petrus Peterson of Lincoln, Nebr., president; Charles L. Kaupke of Fresno, Calif., 1st vice president; State Senator Earl T. Bower of Warland, Wyo., 2nd vice president; and Herbert L. Buck of Billings, Mont., treasurer. In addition, Fred Wilson of New Mexico and LaSalle Coles of Oregon were elected to serve with these officials on an Executive Committee.

Retiring NRA President Harry E. Polk presided over the meetings, which included an important address by Congresswoman Reva Beck Bosone of Utah, entitled "Small Projects Bring Big Problems," a speech by Wyoming's Governor Frank A. Barrett on the nation's need for western reclamation, Commissioner of Reclamation Michael W. Straus' talk on the future of reclamation, and many other significant discussions.

In conjunction with, and prior to the NRA meeting, the Association of Western State Engineers held their annual meeting in Amarillo. •

Water Stored in Reclamation Reservoirs

Location	Project	Reservoir	Storage (in acre-feet)		
			Active capacity [1]	Sept. 30, 1950	Sept. 30, 1951
Region 1	Baker	Thief Valley	17, 400	600	2, 500
	Bitterroot	Lake Como	34, 700	12, 600	7, 600
	Boise	Anderson Ranch	464, 200	266, 900	344, 600
		Arrowrock	286, 600	10, 000	36, 100
		Deadwood	161, 900	127, 000	0
		Lake Lowell	169, 000	38, 900	53, 200
	Burnt River	Unity	24, 600	5, 200	2, 600
	Columbia Basin	F. D. Roosevelt	5, 220, 000	5, 200, 000	5, 220, 000
	Deschutes	Crane Prairie	50, 000	34, 700	57, 000
		Wickiup	182, 000	28, 300	19, 000
	Minidoka	American Falls	1, 700, 000	923, 600	1, 021, 300
		Jackson Lake	847, 000	568, 500	622, 700
		Lake Walcott	95, 200	93, 300	94, 000
		Grassy Lake	15, 200	12, 200	12, 100
		Island Park	127, 300	87, 900	86, 400
	Okanogan	Conconully	13, 000	3, 600	7, 500
		Salmon Lake	10, 500	10, 100	10, 200
	Owyhee	Owyhee	715, 000	350, 100	390, 700
	Umatilla	Cold Springs	50, 000	6, 100	400
		McKay	73, 800	22, 300	13, 800
	Vale	Agency Valley	60, 000	0	3, 000
		Warm Springs	191, 000	0	5, 000
	Yakima	Bumping Lake	33, 800	4, 600	3, 000
		Cle Elum	435, 700	229, 700	159, 500
		Kachess	239, 000	129, 800	123, 800
		Keechelus	153, 000	86, 800	55, 000
		Tieton	197, 000	112, 400	80, 600
Region 2	Central Valley	Millerton Lake	500, 000	57, 100	125, 100
		Shasta	4, 366, 800	2, 702, 000	2, 431, 400
	Klamath	Clear Lake	513, 300	87, 900	66, 700
		Gerber	94, 300	10, 200	18, 200
		Upper Klamath Lake	524, 800	266, 000	214, 400
	Orland	East Park	50, 600	10, 100	10, 200
		Stony Gorge	50, 000	6, 600	3, 800
Region 3	Boulder Canyon	Lake Mead	27, 207, 000	19, 751, 000	19, 118, 000
	Parker	Havasu	688, 000	586, 600	600, 900
	Salt River	Bartlett	179, 500	2, 900	25, 000
		Horse Mesa	245, 100	200, 800	62, 000
		Horseshoe	144, 000	800	7, 000
		Mormon Flat	57, 900	52, 200	18, 000
		Roosevelt	1, 381, 600	5, 200	87, 000
		Stewart Mountain	69, 800	45, 600	38, 000
Region 4	Fruit Growers	Fruit Growers	4, 500	700	300
	Humbolt	Rye Patch	179, 000	28, 900	85, 300
	Hyrum	Hyrum	15, 300	6, 900	5, 600
	Moon Lake	Moon Lake	35, 800	10, 900	11, 900
	Newlands	Lahontan	290, 900	159, 800	110, 000
		Lake Tahoe	732, 000	332, 400	531, 600
	Newton	Newton	5, 300	1, 100	1, 500
	Ogden River	Pine View	44, 200	15, 600	13, 400
	Pine River	Vallecito	126, 300	24, 800	22, 400
	Provo River	Deer Creek	149, 700	123, 300	117, 700
	Scofield	Scofield	65, 800	26, 900	26, 700
	Strawberry Valley	Strawberry	270, 000	123, 800	132, 700
	Truckee River Storage	Boca	40, 900	27, 700	27, 800
	Uncompahgre	Taylor Park	106, 200	35, 200	45, 500
	Weber River	Echo	73, 900	39, 500	38, 400
Region 5	W. C. Austin	Altus	145, 000	148, 900	100, 600
	Balmorhea	Lower Parks	6, 000	3, 000	100
	Carlsbad	Alamogordo	131, 900	95, 200	13, 200
		Avalon	6, 600	5, 500	6, 000
	Rio Grande	Caballo	345, 900	43, 100	9, 600
		Elephant Butte	2, 197, 600	333, 400	19, 400
	Tucumcari	Conchas	269, 100	214, 000	135, 300
Region 6	Belle Fourche	Belle Fourche	185, 200	47, 900	44, 000
	Milk River	Fresno	127, 200	34, 100	94, 900
		Nelson	68, 800	19, 000	42, 500
		Sherburne Lakes	66, 100	22, 000	15, 600
	Riverton	Bull Lake	155, 000	101, 300	146, 600
		Pilot Butte	31, 500	6, 200	4, 200
	Shoshone	Buffalo Bill	394, 600	391, 300	389, 700
	Sun River	Gibson	105, 000	63, 500	70, 100
		Pishkun	30, 100	23, 800	24, 500
		Willow Creek	32, 400	21, 200	23, 600
Region 7	Colorado-Big Thompson	Green Mountain	146, 900	119, 400	132, 300
	Kendrick	Alcova	190, 300	173, 000	162, 300
		Seminoe	993, 200	713, 000	908, 300
	Mirage Flats	Box Butte	30, 600	10, 300	17, 900
	North Platte	Guernsey	44, 200	16, 900	0
		Lake Alice	11, 000	2, 400	3, 000
		Lake Minatare	60, 800	13, 900	21, 000
		Pathfinder	1, 040, 500	587, 800	371, 300

[1] Available for irrigation.

CROPS

Crop Values Hit All-Time High

Preliminary estimates of more than 13 million tons for crops produced on Reclamation projects as published in our July issue, page 155, prove to be overly modest now that the final returns are in.

Actually more than 16,083,000 tons of food and forage were produced on 5,077,000 acres of land irrigated by Reclamation facilities on 62 projects. The previous record volume for crop production was scored in 1946 with a 14,400,000-ton production.

As to total value, 1950 set another record at $578,238,000 or 23 million dollars greater than the previous high of 1947's $555 million. Last year marked the fifth consecutive year that Reclamation crops were valued at more than half a billion dollars.

The total production was 2.8 million tons of hay and forage; 4.3 million tons of vegetables and truck; 4 million tons of sugar beets, and 1.4 million tons of fruits and nuts. Per-acre crop value climbed from an average of $105.03 in 1949 to $111.43 in 1950, the sixth straight year of crop value over $100 per acre.

Estimates based on both crop tonnage and acres irrigated indicate that from 250 to 300 million tons of fruits and vegetables, cotton, sugar beets, and feed and forage have been produced on Reclamation watered lands since the initial water delivery in 1906. The value of these crops served in whole or in part by Reclamation facilities since 1906 is set at 7.1 billion dollars.

Bureau built facilities were extended to provide service for additional acreage on 22 projects in the West in 1950, the greatest increase being on the Central Valley project in California where 172,000 acres were provided with supplemental water for the first time during the year. ●

LETTERS

Testimonials

Our mail box last month carried an exceptionally large number of congratulatory comments, from which we select a few typical excerpts:

From compressed air magazine, Phillipsburg, N. J., Jack C. Pierce, assistant editor, said, "Your September 1951 issue of the Reclamation Era is customarily fine but unusually interesting to us. Water and the World, Fly Ash Saves Money and Strengthens Canyon Ferry, and Roof Bolts for Duchesne, all struck our fields of interest, but Gassing the Gophers by Hu Blonk stands out as a unique application of compressed air."

From san leandro, calif., Sam Mituyosi writes, "The new Reclamation Era is very interesting. May I subscribe?"

From hilo, hawaii, Ellwood Lewis Bartz writes, "The Reclamation Era is an excellent publication in its field . . . I am a Hydraulic Engineer with the Territorial Department of Public Works and am at present working on the development of an irrigation and water utilization project on this island . . . My problem in general is to investigate the rainfall and runoff in a specified area and then locate and design storage facilities and distribution systems for the use of this water on tillable lands which presently are unused because of lack of adequate water supply. Mehalo nui and aloha from Hawaii Nei (which translated means, "many thanks and best wishes from greater Hawaii")."

From fairhope, ala., Robert C. Keeney writes, "This (meaning the Reclamation Era) is one of the best informative publications I know for the price, and it's more interesting to me as I am somewhat familiar with western irrigation and we are starting to use it here in this county a little more each year."

We are not bragging. We just want our contributors to know how much their work is appreciated by our subscribers.

OUR BACK COVER is based upon a photograph of a relief model of the United States and reproduced with the permission of the copyright owners, Kittredge and Coolidge.

RELEASES

Reclamation Handbooks Help Japan

According to a press statement from the Natural Resources Section of the Japanese Government, a recent arrival of a shipment of engineering handbooks, obtained by arrangement with and the cooperation of the United States Bureau of Reclamation was exceptionally timely in view of the large number of river utilization projects now being considered by the various Japanese agencies.

Selected portions of the handbooks are to be translated into Japanese. ●

New Yakima Project Folder Available

A new illustrated folder on the Bureau's Yakima project, located in the central part of Washington State is now available to the public.

There is no charge for this folder. Copies may be obtained by writing to the Regional Director, Bureau of Reclamation, Box 937, Reclamation Building, Fairgrounds, Boise, Idaho. ●

New Maps Available

The Drafting Section of the Bureau of Reclamation has recently completed the following project maps: Grand Valley project, Colo.; Humboldt project, Nev.; Frenchman-Cambridge Division, Missouri River Basin project, Nebr.; Lower Marias Unit, Lower Marias Division, Missouri River Basin project, Mont.; Yellowstone Division, Missouri River Basin project, Mont.; and Uncompahgre project, Colo.

These maps are available in both the small (10½ by 17) and large (21 by 34) sizes. The maps are all in color and requests should be sent to the nearest regional director (see directory on inside back cover of this issue), specifying the name and size of the maps desired. Single copies are available free to those who need them in connection with their work or studies. ●

Through an unfortunate oversight, the photos appearing on page 221 of the October 1951 issue, illustrating the article entitled, "Fort Sumner Fortified," did not carry the names of the Region 5 photographers. Fred Finch took the photo of the dam, and William N. Roth photographed the canal.

NOTES FOR CONTRACTORS

Contracts Awarded During September 1951

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DS-3350	Davis Dam, Ariz.-Nev.	Sept. 10	Radio communication equipment, including 25 mobile radio transmitter-receiver assemblies.	Link Radio Corp., New York, N. Y.	$36,628
DC-3413	do	Sept. 4	Completion of Davis Dam spillway stilling basin and excavation for Colorado River channel improvement.	Grafe-Callahan Construction Co., Dallas, Tex.	2,731,882
DC-3457	Columbia Basin, Wash.	Sept. 20	Painting steel liners of 102-inch outlet works conduits in spillway section of Grand Coulee Dam.	Wiscombe Painting and Decorating Co., Salt Lake City, Utah.	87,000
DS-3465	Colorado-Big Thompson, Colo.	Sept. 14	1 station-service power distribution board for Pole Hill power plant, schedule 1.	Wolfe and Mann Mfg. Co., Baltimore, Md.	12,828
DS-3476	do	Sept. 26	1 controlling and two controlled station supervisory control and telemetering switchboard cubicles and equipment and 1 lot of carrier-current equipment for Granby pumping plant and Willow Creek Dam and pumping plant.	Control Corp., Minneapolis, Minn.	31,492
DS-3478	Columbia Basin, Wash	Sept. 27	8 replacement bushings for power circuit breakers for Grand Coulee 230-kilovolt right switchyard.	General Electric Co., Denver,	44,000
DS-3491	Kendrick, Wyo	Sept. 14	2 16,500/22,000 kilovolt-ampere transformers with 3 lightning arresters for Alcova switchyard, schedule 1.	Westingbouse Electric Corp., Denver, Colo.	149,272
Do	do	do	3 115,000-volt circuit breakers for Alcova switchyard, schedule 2	Pacific Electric Manufacturing Corp., San Francisco, Calif.	72,023
DS-3497	Missouri River Basin, Wyo.	Sept. 21	1 control board, 2 carrier-current relaying transmitter-receiver sets, and 1 set of line protective and carrier-current relays for Lovell and Thermopolis substations.	General Electric Co., Denver, Colo.	23,629
DC-3500	Cachuma, Calif	Sept. 11	Construction of concrete-lined Sheffield tunnel, Carpinteria section, South Coast conduit.	A. J. Cheff Construction Co., Seattle, Wash.	855,472
DC-3501	Kendrick, Wyo	Sept 13	Construction of 36 miles of Seminoe-Bairoil 34.5-kilovolt transmission line.	L and S Construction Co., Casper, Wyo.	64,477
DC-3502	Central Valley, Calif	do	Construction of Tracy switchyard 115 and 69-kilovolts switchyard additions.	Del Monte Electric Co., Oakland, Calif.	150,628
DC-3503	Colorado-Big Thompson, Colo.	Sept. 18	Construction of Rattlesnake Dam, Estes Park-Foothills power aqueduct.	Adler Construction Co., Loveland, Colo.	825,280
DS-3504	Central Valley, Calif	Sept. 20	1 lot of distribution piping and appurtenances for Tranger pumping plant, Lindsay-Strathmore irrigation district, Friant-Kern canal distribution systems.	Southwest Welding & Manufacturing Co., Alhambra, Calif.	84,545
DS-3505	Missouri River Basin, S. Dak.	Sept. 5	10 potential and 3 current transformers for Huron, Mount Vernon, Watertown, and Sioux Falls substations.	Gough Industries, Inc., Los Angeles, Calif.	21,921
DS-3507	Colorado-Big Thompson, Colo.	Sept. 24	1 76-inch butterfly valve for Flatiron power and pumping plant, item 1.	Guy F. Atkinson Co. d. b. a. Willamette Iron and Steel Co., Portland, Oreg.	58,422
DC-3510	Middle Rio Grande, N. M.	Sept. 25	Construction of channelization of the Rio Grande River from San Marcial to the narrows of Elephant Butte reservoir.	McGinnes Bros., Inc., Houston, Tex.	940,115
DC-3515, DC-3516, DC-3517	Missouri River and Basin, S. Dak.	Sept. 24	Construction of Winner, Bonesteel, and Gregory substations	C-L Electric Co., Pocatello, Idaho.	109,442
DC-3523	Eklutna, Alaska	Sept. 17	Construction of Eklutna tunnel, schedule 1	Palmer Constructors (Consisting of Peter Kiewit Sons' Co. Coker Construction Co. and Morrison-Knudsen Co., Inc.) Omaha, Nebr.	17,348,865
117C-113	Columbia Basin, Wash.	Sept. 20	Watermaster office building, service buildings and permanent residences for O & M Headquarters at Eltopia, Wash.	Westover & Hope, Quincy, Wash.	169,831
601C-17	Missouri River Basin, Wyo.	Sept. 6	Exploratory drilling for Raft Lake Du Noir, Red Bluff, North Fork and Soral Creek dam sites.	Boyles Bros. Drilling Co., Salt Lake City, Utah.	27,460
704C-178	Colorado-Big Thompson, Colo.	Sept. 7	Construction of garage and shop buildings at Brighton, Beaver Creek, Sterling, and Yuma substations.	John A. Bell, Berthoud, Colo.	21,845
703C-214	Missouri River Basin, Wyo.	Sept. 18	Seminol-Kortes control cable line	American Electric Co., Caldwell, Idaho.	35,000
704S-199	Colorado-Big Thompson, Colo.	Sept. 5	Electrical equipment for Gunnison and Salida substations, schedule 1.	Pennsylvania Transformer Co., Cannonsburg, Pa.	70,698
704S-199	do	Sept. 6	Electrical equipment for Gunnison and Salida substations, schedules 3, 5, 10, 11, 12, 13, and 14.	Westinghouse Electric Corp., Denver, Colo.	34,803

Construction and Materials for Which Bids Will Be Requested by January 1952

Project	Description of work or material
W. C. Austin, Okla.	Construction of 8 miles of drains and drainage structures and placing asphalt membrane lining on 0.5 mile of 400 cubic feet per second capacity Altus canal, near Altus, Okla.
Boulder Canyon, Ariz.-Calif.	Construction of 5.4 miles of 12- to 42-inch diameter concrete pipelines for unit 9, part II of the Coachella Valley distribution system, near Coachella, Calif.
Cachuma, Calif.	Construction of Lauro chlorination and control house, an 18- by 65-foot concrete building near Santa Barbara Calif.
Do	Construction of 16 miles of concrete pipe conduit, varying in size from 36- to 27-inch diameter, and three control stations, part of the Carpinteria section of South Coast conduit near Santa Barbara, Calif.
Central Valley, Calif.	Construction of 160,000-kilowatt Folsom power plant. This semi-outdoor type plant will require construction of a reinforced concrete structure about 120 by 240 feet and 107 feet high, and installation of three 74,000-horsepower turbines and a 300-ton gantry crane.
Central Valley, Calif.	Constructing about 20 miles of 230-kilovolt steel-tower transmission line between Elverta and Folsom, Calif.
Do	Fabricating and erecting safety cages for vertical ladders for elevated water tank at Tracy pumping plant.
Do	Construction of 43 miles of pipelines for Exeter irrigation district on the Friant-Kern canal distribution system, near Exeter, Calif. Contractor is to furnish the 12- to 42-inch diameter pipe with heads up to 75 feet.
Do	Three 4- by 19-foot and one 8- by 19-foot water screens with metalwork for Exeter irrigation district No. 2 on the Friant-Kern canal distribution system.
Colorado-Big Thompson, Colo.	Installation of 40,000-kilovolt-ampere synchronous condenser, 3 single-phase 16,000-kilovolt-ampere transformers, one 300-kilovolt-ampere station service transformer, and switching equipment; and erecting steel structures for addition to 115-kilovolt Beaver Creek substation near Brush, Colo.

Construction and Materials for Which Bids Will Be Requested by January 1952—Continued

Project	Description of work or material
Colorado-Big Thompson, Colo.	Construction of 10 miles of 625- to 575-cubic feet per second capacity, partially lined St. Vrain supply canal, including a 50-cubic feet per second turnout feeding into the Little Thompson River, two 8.5-foot horseshoe shape tunnels, totaling 4,350 feet in length, and a 1,300-foot long 8.5-foot circular siphon, and other siphons, chutes, and spillways, near Lyons, Colo.
Columbia Basin, Wash.	Painting metalwork at Grand Coulee Dam and right powerhouse, and 150,000 gallon water tank on right abutment at Coulee Dam.
Do	Construction of 48 miles of unlined laterals and wasteways of 119- to 2-cubic feet per second capacity to irrigate about 18,000 acres in lateral area E–4 on the East Low Canal, 2 to 8 miles north of Warden, Wash.
Do	Construction of 20 miles of unlined laterals and wasteways of 180- to 2-cubic feet per second capacity to irrigate about 6,000 acres in lateral area P–3 on Potholes East Canal, 2 to 6 miles northwest of Mesa, Wash.
Do	Modification of Pasco relift pumping plant near Pasco, Wash.
Do	Drilling exploratory water supply well on part-time farm unit area near Soap Lake, Wash.
Do	Removing existing dike and constructing two new dikes in Trail Lake section of main canal about 6 miles south of Coulee City, Wash.
Do	Installation of miscellaneous equipment and machinery in operation and maintenance division headquarters shop at Quincy and Othello, Wash.
Do	Construction of 21- by 13-foot permanent vault and 21- by 20-foot temporary storage room in Ephrata warehouse.
Do	Construction of 6 miles of 30-cubic feet per second capacity lined channel, 6 miles of 60-cubic feet per second capacity unlined channel, and 9 culverts for interception and conveyance of excess ground water in vicinity of Soap Lake, Wash.
Do	Construction of Lower Saddle Gap, Upper Saddle Gap, and PE–17 pumping plants and related laterals on Potholes East Canal. Work includes furnishing and erecting prefabricated steel buildings and constructing wasteways, 1,600 feet of lateral, and 20 miles of sublaterals in P1 and P13 lateral areas, 5 miles southwest of Othello, Wash.
Do	One horizontal-shaft, centrifugal-type pumping unit, 5 cubic feet per second capacity at 64-foot head for EL 42.9 pumping plant; one vertical-shaft, turbine-type pumping unit, 3 cubic feet per second capacity at 20-foot head for EL 51.3 pumping plant; and one horizontal-shaft centrifugal-type pumping unit, 32 cubic feet per second capacity at 60-foot head for EL 55 pumping plant for Area E–4 on East Low Canal.
Do	Construction of 19 miles of unlined Potholes East Canal, 470 cubic feet per second capacity, including concrete chute and stilling pool, concrete drop and stilling pool, 8 concrete checks; and construction of Pasco wasteway turnout and chute, Pasco wasteway, and 7 county bridges, near Ringold, Wash.
Davis Dam, Ariz.-Nev	Erection of steel structures and installation of electrical equipment for the 69-kilovolt switchyard and transformer circuits at Davis Dam, Ariz.
Eklutna, Alaska	One 7.08- by 9-foot bulkhead gate with frame, anchors, and hydraulic hoist for Eklutna tunnel.
Gila, Ariz.	Construction of 28 miles of unreinforced concrete-lined Mohawk laterals and sublaterals of 120 to 15 cubic feet per second capacities, and appurtenant reinforced concrete structures, and removal of existing timber and concrete structures for unit 1, near Roll, Ariz.
Kendrick, Wyo.	Construction of 12 two-bedroom conventional-type wood-frame houses with full basement and attached garage near Alcova Dam, about 32 miles southwest of Casper, Wyo.
Do	Construction of about 35 miles of double-circuit telephone line from new Casper substation to Alcova Dam.
Middle Rio Grande, N. Mex.	Construction of 17 miles of Rio Grande River drainage and conveyance channel and levee from San Marcial, N. Mex., to channel headworks.
Missouri River Basin, Nebr.	One 30,000-kilovolt-amper 3-phase synchronous condenser for Gering substation.
Missouri River Basin, Nebr.-S. Dak.	Installing Government-furnished armor-rods and vibration dampers and changing overhead ground wire connections on 98 miles of 115-kilovolt transmission line between Alliance and Chadron, Nebr., and between Fort Randall dam site, S. Dak., and O'Neill, Nebr.
Missouri River Basin, Mont.	150,000 pounds of fabricated galvanized structural steel for bolted switchyard structures at Canyon Ferry power plant.
Missouri River Basin, S. Dak.	Construction of 26,000-kilovolt-ampere Brookings substation.
Do	Construction of 7,500-kilovolt-ampere Summit substation.
Do	Construction of 7,500-kilovolt-ampere Tyndall substation.
Do	Construction of 10,000-kilovolt-ampere Armour substation.
Do	Construction of 15,000-kilovolt-ampere Beresford substation.
Do	Construction of 15,000-kilovolt-ampere Flandreau substation.
Do	Construction of 10,000-kilovolt-ampere Groton substation.
Do	Construction of 2,500-kilovolt-ampere Wall substation.
Do	Construction of 3,750-kilovolt-ampere Philip substation.
Do	Construction of 5,000-kilovolt-ampere Midland substation.
Do	Construction of 2,000-kilovolt-ampere Wicksville substation.
Do	Construction of metal or concrete block warehouses and storage garages at Armour, Sioux Falls, Watertown, and Philip substations.
Riverton, Wyo.	Furnishing and applying asphalt lining on about 11 miles of Wyoming canal and Badger lateral.
Shoshone, Wyo.	Construction of 4,400 feet of open drains, 2,885 feet of closed 10-inch tile drain and 7 structures on Heart Mountain division near Cody, Wyo.

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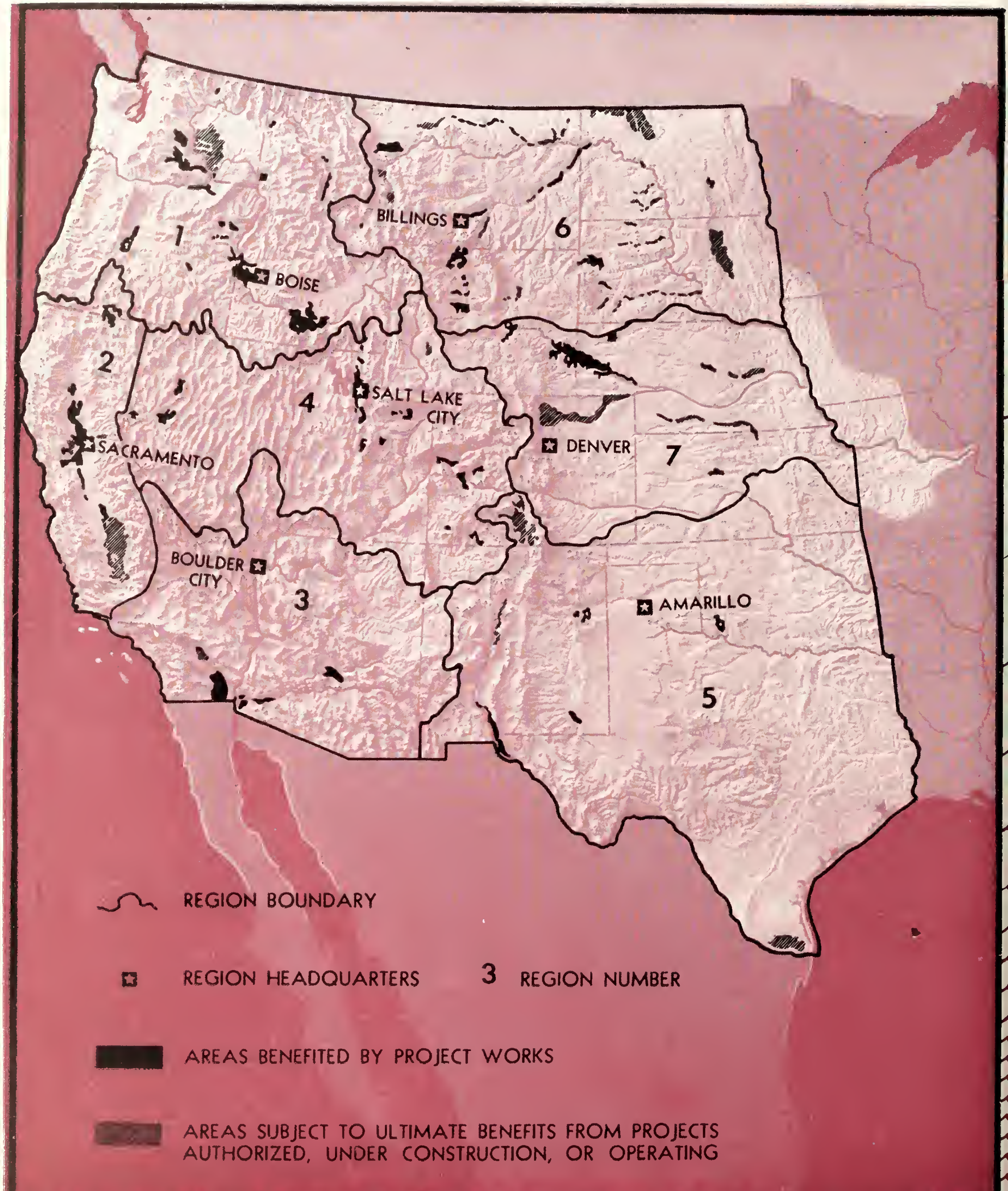
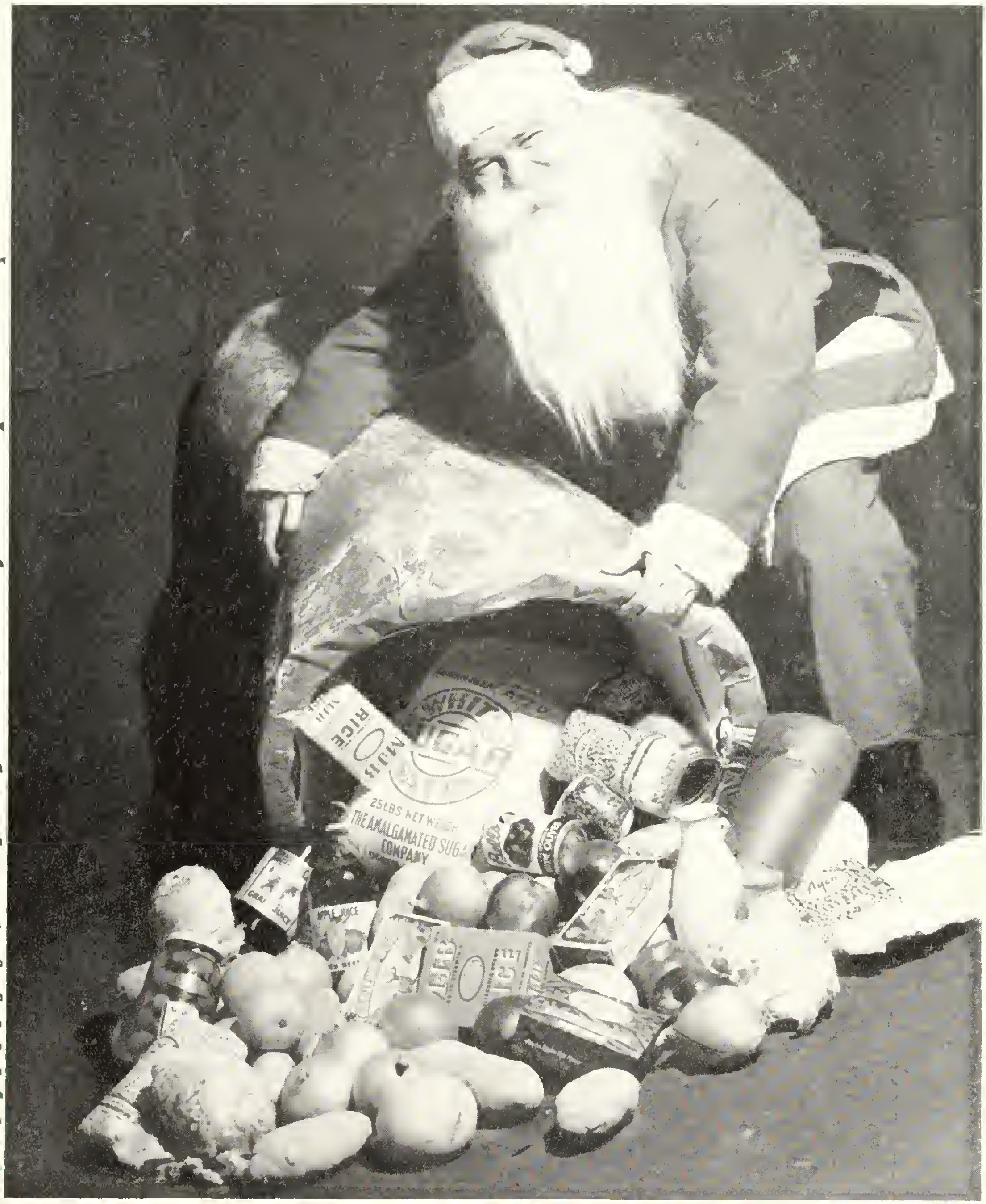


THE RECLAMATION AREA

The Reclamation ERA

December
1951



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Ruth F. Sadler, *Editor*

Subscription rate $1.50 a year for persons residing in the United States and Canada; $2 a year for foreign subscriptions; special rate of $1 a year for members of water users' associations, and Bureau of Reclamation employees.

OUR FRONT COVER

Season's Greetings

Federal Reclamation, in the figurative form of Santa Claus, presents the Nation with food of all kinds from his horn of plenty. Photo by Phil Merritt, Region 1, photographer.

30 YEARS AGO IN THE ERA

Greetings to our Project People

To Okanogan, on the North, and Yakima just below, looking out upon the snowy crests of the Cascades; to Klamath amid her forests and lakes; to Umatilla, beside the mighty Columbia; to Orland, project of no regrets; to Newlands, the milk and honey land; Yuma and Salt River, our tropic gardens; Rio Grande, the leader in cooperation; Carlsbad, in the land of turquoise skies, Uncompahgre, blessed by the Gunnison's flow; Grand Valley, where dreams come true; Strawberry, the promised land of the Saints; Flathead, the new land of Opportunity; to Minidoka, where night is dispelled and labors lessened by harnessed lightning; and Boise, gem of Idaho's fertile valleys; to King Hill, the adopted child of the service; to Milk River, Lower Yellowstone, Sun River, and Huntley, Montana's quartette; to Belle Fourche, shadowed by the pines of the Black Hills; to Williston on the Big Muddy; to Shoshone, the Land of Fulfillment; to the North Platte, along the River of Castles; Riverton, soon to blossom; and to Fort Peck and Blackfeet, our Indian projects, we extend felicitations and best wishes for a Merry Christmas.

(From p. 550 of the December 1921 issue of the RECLAMATION RECORD, predecessor of the RECLAMATION ERA.)

RECLAMATION PLACE NAMES IN THIS ISSUE

Reclamation's Golden Jubilee

by Michael W. Straus, Commissioner
Bureau of Reclamation

Extracts from Commissioner Straus' address of October 18, 1951, during the Twentieth Annual Convention of the National Reclamation Association at Amarillo, Tex., containing important official policy statements and a year-end report on the status of the Bureau of Reclamation's program.

RECLAMATION'S GOLDEN JUBILEE will occur on June 17, 1952. Let us take a look back over our half century of experience. We have a tendency to dwell on the changes that have occurred. What I want to emphasize now are some changes which have not occurred.

The Reclamation program began as a measure for improving lands sufficiently to attract homesteaders and expand western opportunities. Today, the Reclamation program irrigates both private and public lands, providing supplementary as well as full irrigation, bolsters private pumping operations as well as public surface diversions, and services whole regions as units. These are tremendous changes in the scale and scope of the program; but the ultimate purpose has not changed. It remains today, as it was in 1902, to open barren or inadequately watered lands to settlers and to fill the land with independent farm families.

The Reclamation program began without tax appropriations. Works on the modern scale were undreamed of. Today, the taxpayers invest about a quarter of a billion dollars each year in the program, and Reclamation undertakes, in its stride, tasks greater than any proposed before in man's history. Yet the economic and financial principles underlying this program have not changed. The tremendous modern projects, like the modest early ones, are still basically self-liquidating and the major costs are still repaid by the water and power beneficiaries.

When Reclamation began, power was at most an incidental technical matter, something an ingenious engineer would pick up to help provide electrical energy for his construction job, such as on the Salt River, Boise, North Platte, Strawberry Valley, and other projects. Today, power is one of the main piers on which rests the entire Reclamation structure, an integral and inseparable part of the operation, a benefit ranking generally with the irrigation benefit itself, but far ahead of the irrigation it makes possible when it comes to paying the bill. From April 16, 1906—the day when the Federal Government first took legislative cognizance of Reclamation power—up to the hectic present, the principles under which that power is made available to the American people have remained unaltered. It is sold preferentially to public bodies and cooperatives; sold in such a way as to assure widespread use and to prevent monopolization, and sold at the lowest possible cost consistent with sound business principles.

Reclamation began with single-purpose irrigation projects. Today, it is based upon gigantic multiple-purpose projects consciously designed to develop entire river systems. Yet from the days when the first two power plants were installed at Roosevelt Dam in Arizona and in the Strawberry Valley in Utah, Reclamation has never been satisfied with half measures. Today, as then, it conceives its duty to consist of getting every benefit possible from the water resources brought under control. Today, as then, it sees each project with its various but interrelated benefits as an integrated unit.

And, in our golden jubilee year, let us remem-

(Please turn to page 286)

FIGHTING CORROSION WITH CORROSION

ARMOR OF ANODES FOR IMPERIAL DAM. At left, grophite onodes sofeguord submerged portion of roller gotes. At right, suspended onodes protect the 24 scrapers at the Imperial Dam ond Desilting Works ot the Colorodo River. *Photo ot left by S. T. Lorsen, Design ond Construction Division, Denver, Colo., at right by Samuel B. Watkins, Region 3 photogropher.*

by J. L. GILLILAND and N. G. NOONAN, Engineers, Design and Construction Division Denver, Colo.

What's a good way to fight corrosion? What is an effective and cheap method of combating this insidious force which attacks metal irrigation structures and annually takes huge bites out of the water users' pocketbooks?

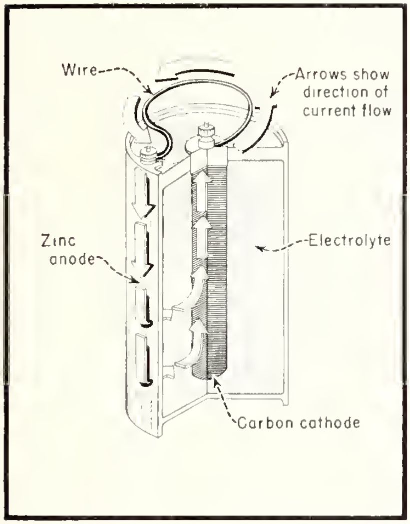
Reclamation engineers say one answer to these questions is to fight fire with fire, or more aptly, to fight corrosion with corrosion, by using a tool called cathodic protection.

Cathodic protection, which uses certain inherent electrical properties of metal, is proving to be one solution to the problem of reducing the large red-ink item of corrosion on the Bureau's operation and maintenance books. Good quality paint work is still the Bureau's first line of defense. But fighting corrosion with corrosion—which essentially is the principle of cathodic protection—will result in a great decrease for this destructive and costly element in Reclamation operation and maintenance work.

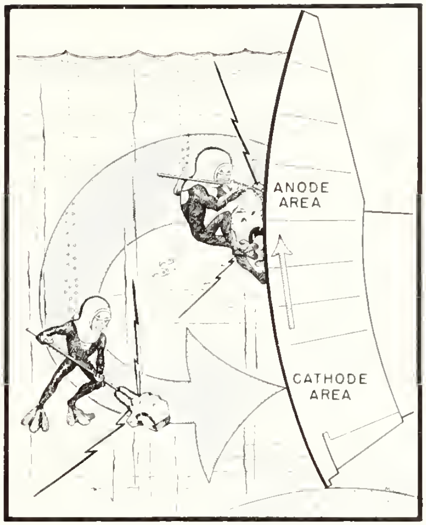
To appreciate the significance of this achievement and its vast importance in Reclamation's activities, let us summarize briefly the over-all corrosion picture.

Fundamentally, corrosion is an electrical—or, more accurately, an electrochemical—process. Certain metals, particularly steel, embody within themselves the electromotive seeds of their own destruction. Metals such as those used on irrigation structures on Bureau projects contain varying degrees of electrification within themselves, technically known as potentials. In the presence of water containing dissolved salts, an eternal triangle is developed between the areas of different potentials called anodes and cathodes, both within the metal, and the surrounding water, called the electrolyte.

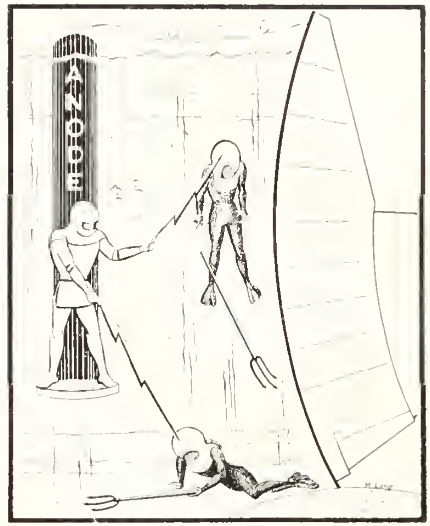
Corrosion is the result of an electric current generated by the difference in potentials which flows from the anode through the electrolyte back to the metal at the cathode side. When the electrical current flows through the water it dissolves metal from the anode area. Dissolved iron, upon exposure to air or oxygen in the water, produces rust. As pitted areas develop, they are surrounded by a wall of rust. Although these currents are very small, their over-all effect is vastly destructive. For example, a small amount of electrical current continuously leaving a metal surface may



LIKE A DRY-CELL BATTERY, when the electric current flows from the zinc anode to the carbon cathode, it removes zinc particles as it leaves the anode, thus corroding the dry-cell case. The battery operates because there is an electric difference in potential between the zinc and carbon.



CORROSION RESULTS FROM ELECTRIC CURRENT, generated by the difference in potentials flowing from the anode to the cathode areas. Physical or chemical variations in submerged metal structures, like the radial gate above, generate this current.



A SACRIFICIAL ANODE takes the corrosive action upon itself, turning the radial gate into a cathode. The protective anode is connected by a wire to the submerged metal structure. *Illustrations by Marie L. Lang, Design and Construction Division, Denver, Colo.*

take as much as 20 pounds of metal with it within a year.

Bureau engineers took a long look at this basic corrosion phenomenon and borrowed a page from the book of experience of pipeline engineers who have solved the similar problem of corrosion on underground steel pipelines. The Reclamation researchers have mitigated the action of corrosion by introducing another element which acts to break up the usual self-destructive process. They have added a material which acts as an anode, causing the entire metal irrigation structure to become the cathode. In other words, the new material is an expendable anode which takes the destructive corrosive action upon itself and at the same time frees the structure from any further damage—thus fighting corrosion with corrosion. The expendable material is called a sacrificial anode because it is consumed in the process of protecting the structure.

Two methods of cathodic protection are used—one called the galvanic method, the other the electrolytic method. The galvanic method, operating automatically, employs a metal anode sufficiently different in potential than the metal to be protected, and containing within itself the electrical energy required to protect the structure. The electroyltic method, however, requires an external source of direct current, usually obtained through rectifiers—devices which change alternating current to direct current.

Zinc and magnesium are used primarily as anodes for the galvanic method of cathodic protection. Because of its large storage capacity for electricity, however, magnesium is the most commonly used galvanic anode. Several materials, including graphite, iron and aluminum are used as anodes to "take the rap" in the electrolytic method.

Reclamation engineers are using both methods of cathodic protection. Their first installation now protects the 72 125-foot-diameter revolving scrapers and submerged metalwork in the three basins at the Imperial Dam and desilting works on the Colorado River. The protective anodes are hung from cables which are supported by 30-foot high wooden poles. Here, the electrolytic method is used, electricity being supplied by rectifiers. Each basin of 24 scrapers requires from 60 to 90 amperes to protect 60,000 square feet of metalwork.

Various types of anodes were tried at the desilting works, including scrap steel rods, which are cheap but must be replaced at about 6-week intervals, and graphite anodes which promise to last a year or more.

The electrolytic method is also used to safe-

(Please turn to page 276)

SELF-FEEDER type of container for range feeding salt-feed mixture in use by Ray Cawden's ranch south of Seligman, Ariz. See plans.

Feeding Salt to Livestock

by E. B. STANLEY, Animal Husbandman, College of Agriculture and Agricultural Experiment Station,

University of Arizona, Tucson, Ariz.

SOMETHING NEW IN LIVESTOCK PRODUCTION has been developed in Arizona.

Cattlemen are mixing salt with cottonseed meal and other supplementary foods to livestock on the open range or pasture. As a result the range animals eat what is good for them, and no more. In addition, this self-regulating use of supplementary feed helps to solve the problem of supporting livestock on drought-stricken desert land.

The advent of self-feeding salt-feed concentrate mixtures to range cattle makes an eventful development in livestock production—particularly in the western range country. It may well be regarded as a contribution of unparalleled significance to the range cattle industry, the major credit for which belongs to Arizona cattlemen and allied interests. The unqualified endorsement of this ingenious practice and its evaluation in the superlative is unquestionably warranted. Some of the conditions that led to the use of salt in this new role and its subsequent widespread adoption throughout this State and elsewhere are worthy of mention.

It should be understood at the outset, that salt is employed directly to regulate consumption of the feed with which it is combined, and indirectly to effect an increased consumption of essential food nutrients for the range cow. The extensive nature of our range lands have confronted stockmen with the insurmountable barrier of providing supplemental feed regularly each day to needy cattle. A solution to this age-long problem arrived with the discovery that mixing salt with cottonseed meal or other feed concentrate would automatically limit their consumption to a desired level. Outright misgivings greeted the first reports of this practice. It was condemned as unorthodox and unscientific. Any conception that it was the beginning of a new era in range livestock feeding probably did not exist.

Grass and other native vegetation in this area is the sole feed resource of a very large number of our beef cattle and sheep population. Despite its invaluable use for this purpose, depending upon herbage vegetation confronts the livestock industry with its most outstanding problem. The greatest difficulty to cope with in this regard is the unpredictable nature and irregularity of the feed supply. A constantly changing nutrient content adds to the complexity of this prevailing condition.

It is in this capacity that the salt-feed mixture has its greatest virtue. With access to feed supple-

TAKING TURNS, cafeteria style, for a salt-feed mixture on the Coyote Springs Ranch, in Lonesame Valley near Prescott, Ariz. Photos submitted by the author.

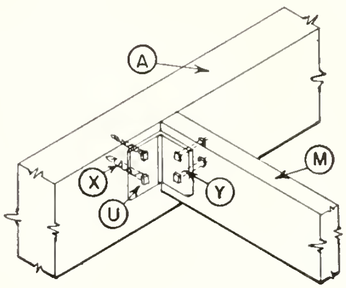
ments when the range forage supply declines below adequate levels, livestock can satisfy their normal feed requirements and maintain a continuity of growth so essential to efficient livestock production.

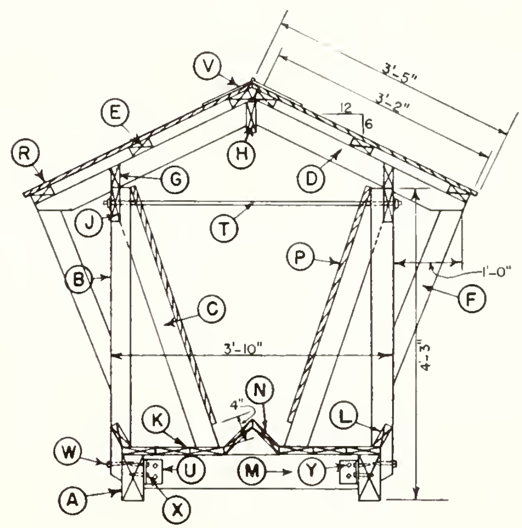
Cottonseed meal or cake has served an important role as a range supplement feed. It was the logical choice to adulterate with salt. In addition to needed protein it provides both phosphorus and readily available energy producing nutrients. Deficiencies common among range cattle grazing on weathered mature forage are protein, energy (digestible nutrients), phosphorus, and vitamin A. Range forage with less than 6.5 to 8 percent crude protein and 0.15 percent phosphorus is deficient in these essential nutrients. Diminished

(Please turn to page 288)

MAKE YOUR OWN OPEN-AIR CAFETERIA FOR LIVESTOCK. Here are detailed plans for a covered self-feeder container with trough insert attachment, portable, and of 1,000 to 1,500 pounds capacity, drawn up by the University of Arizona Agricultural Extension Service, Tucson, Ariz. They call this a Portable Cattle Self Feeder. *Plans made available by the author.*

DETAIL OF ANGLE CONNECTION



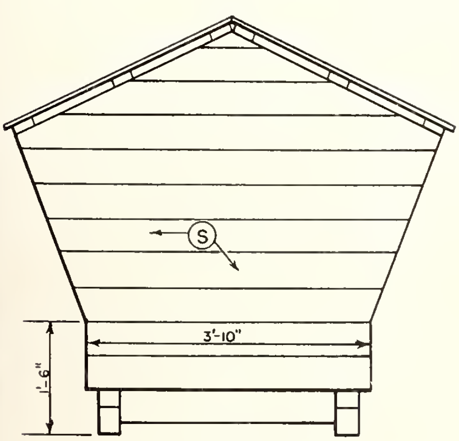


SECTION

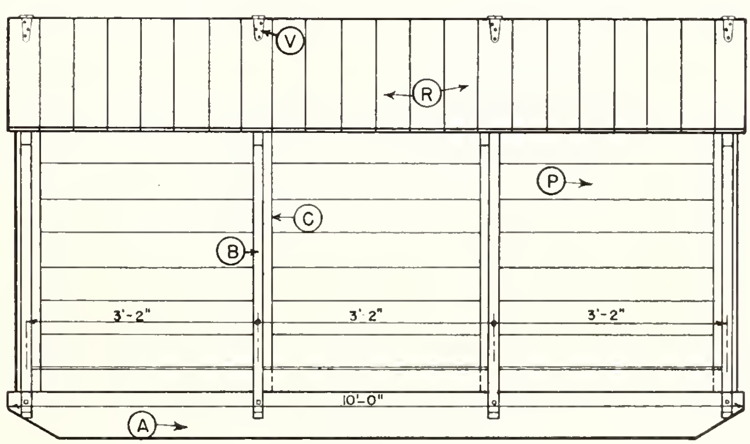
BILL OF MATERIALS

No.	Quantity	Size	Title
A	2	4″ x 8″ x 10′-0″	Skids.
B	8	2″ x 4″ x 4′-0″	Columns.
C	8	2″ x 4″ x 3′-9″	Supports.
D	8	2″ x 4″ x 3′-2″	Rafters.
E	6	2″ x 4″ x 9′-11″	Purlins.
F	4	2″ x 4″ x 2′-7″	End supports.
G	6	2″ x 4″ x 3′-0½″	Blocking.
H	1	2″ x 6″ x 9′-7½″	Ridge.
J	2	2″ x 6″ x 9′-7½″	Stringers.
K	6	2″ x 6″ x 9′-7½″	Flooring.
L	6	2″ x 6″ x 3′-0½″	Bankboard.
M	4	2″ x 6″ x 2′-11″	Joists.
N	2	2″ x 8″ x 9′-7½″	Flooring.
P	14	1″ x 6″ x 9′-7½″	Sheeting.
R	22	1″ x 6″ x 3′-5″	Sheathing.
S	[1] 70	1″ x 6″	Sheeting.
T	4	½″ dia. rod x 4′-0″	Tie (nuts and washers).
U	8	3″ x 3″ x ¼″ L x 4″	Clip L's.
V	4	9″	Strap hinges.
W	8	⅜″ dia. x 5″	Lag screws.
X	16	¼″ dia. x 3″	Do.
Y	16	¼″ dia. x 2½″	Bolts (nuts and washers).

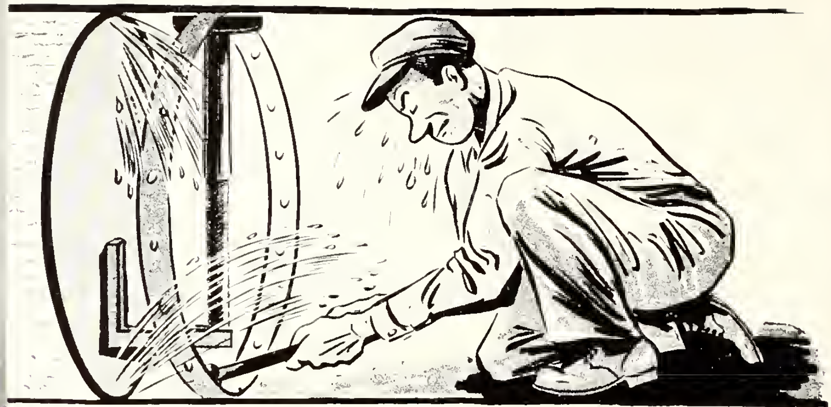
[1] Linear feet.



END ELEVATION



SIDE ELEVATION



JACKING UP THE GATE of the Pleasant Valley Dam meant that Reynold L. Johnston, *manager of the Pleasant Valley Irrigation Co.*, had to crawl the length of the 240-foot tunnel with heavy equipment to renovate the outlet gate. *Photo by Stanley Rasmussen, Region 1 photographer. Artist's impression of Reynold at work by Lloyd Chellman, Graphics Section, Washington, D. C.*

Ingenuity Keeps the Water Flowing

by R. B. HILL, Irrigation Engineer, Region 1 Headquarters, Boise, Idaho

HOW TO OPERATE THE OUTLET WORKS of a reservoir, with the stem of the slide gate sheared off at the gate level under 34 feet of water is a knotty problem.

It was the seemingly insurmountable predicament that recently faced R. L. Johnston, manager of the Pleasant Valley Irrigation Co. in southern Idaho. How he ingeniously overcame the difficulty at a total material cost of $300 and kept the farms supplied with water is the subject of this story.

The Pleasant Valley Irrigation Co. operates a reservoir, known as Pleasant Valley Reservoir, on Ten Mile Creek, about 10 miles south and 3 miles east of Boise. It supplies water for a small number of farms along the creek above the Bureau of Reclamation's Boise project.

The irrigation supply is impounded by an earthfill dam about 40 feet high. The discharge tunnel through the dam, measuring 30 inches wide and 32 inches high, extends 260 feet downstream from the control gate. The first, or upstream 3½ feet of the tunnel, passes through a 30-inch steel pipe, encased in concrete. The gate itself, made of cast iron 3 feet wide by 4 feet high, had been raised and lowered by a manual worm gear hoist, mounted on top of a vertical wooden tower, 46 feet above the gate.

In February 1950, during a severe windstorm, the wooden tower was blown over, shearing off the gate stem at a point just above the outlet gate, which was then under 34 feet of water.

Johnston sought to secure a diver to repair the gate stem. Indicated costs appeared prohibitive and there was no assurance that the job could be completed successfully.

But Johnston was not discouraged. He had an idea. Despite the cramped quarters in the 260-foot tunnel, Johnston believed he could raise and lower the gate as much as 8 inches if he could fasten the base of a double-action hydraulic jack to the outlet pipe with the oil-driven stem of the jack attached to the gate.

Accordingly, he attached the jack inside a steel band, which in turn he fastened inside the outlet pipe as near the gate as possible. The jack stem head was then attached to the discharge gate.

Johnston made the steel band of 1¼- by 4-inch stock, with the outside diameter slightly smaller than the 30-inch inside diameter of the outlet pipe. He drilled ¾-inch holes at intervals of approximately 6 inches around the steel band. Then despite lack of working room at the upstream end of the tunnel and the continual spray of water leaking around the gate, he used a tem-

Three-Firm Combine Starts Eklutna Tunnel

Secretary of the Interior Oscar L. Chapman on September 17 announced the award for construction of a 4-mile long, 9-foot transmountain water diversion tunnel and appurtenant facilities on the Eklutna project in Alaska for defense and industrial electric power in the Anchorage area. The successful bid of $17,348,865 was made by the Palmer Constructors of Omaha, Nebr., a three-firm combine made up of Peter Kiewit Sons, Coker Construction Co., and Morrison-Knudsen Co.

Under the terms of the new bid the Bureau of Reclamation will save almost 4 million dollars. A previous offer of $21,321,695 last June was rejected because the cost was considered excessive.

The contract provided for construction to begin not later than October 17, 1951 and be completed September 1954. When the steel-helmeted engineers started drilling the tunnel it marked the first major contract ever awarded by the Bureau for work on a project outside the mainland of the United States. Besides the tunnel, which will be driven through Goat Mountain to Knik Arm, an inlet of the sea, the job also calls for the construction of a 9-foot diameter concrete gate shaft, a concrete surge tank, 30 feet in internal diameter, and a penstock tunnel, with installation of a 7½-foot diameter penstock. The contractors must also make some alterations on the existing Eklutna Dam.

(See the following issues of the Reclamation Era for additional information on Eklutna: Alaska Far from Forgotten Land—January 1949—page 1, Eklutna Number One Job in Alaska—February 1949—page 35, Reclamation on Ice—April 1949—page 95, Eklutna Reports Goes to Congress—January 1950—page 18, and Byron G. Felkner to Engineer Eklutna—November 1950—page 208. ●

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plate and drilled matching holes in the steel outlet pipe.

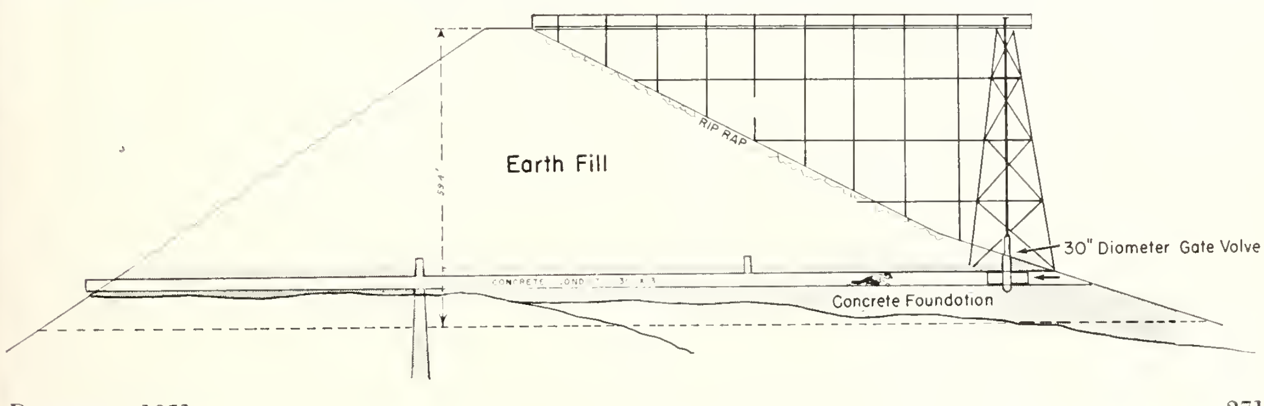
Before mounting the steel band in place, he welded the base of a double-action 5-ton hydraulic jack to the inside of the steel ring. He welded a heavy angle iron to the head of the jack stem. Then slowly, inch by inch, Johnston dragged the assembled steel ring and jack the entire length of the 260-foot tunnel and attached the ring inside the outlet pipe by means of ¾-inch stud bolts. The ring was placed so that the base of the jack was in an inverted position against the top of the steel ring and outlet pipe. With the jack stem fully extended, one lip of the angle iron rested squarely against the cast iron discharge gate. With this equipment in place, he then drilled and threaded holes in the gate and bolted the angle iron to the gate.

To provide power for raising and lowering the gate, Johnston fabricated a small oil pressure pump which was placed near the tunnel outlet. The pipelines, to translate the oil pressure from the pump to the hydraulic jack, consisted of two lines of ½-inch galvanized iron pipe, each about 300 feet long. In order to bleed the lines and remove all air, valves had to be placed on the pipes at points near the hydraulic jack. This meant that Johnston had to be at the upper end of the tunnel during the tryout of the pump to open and close the valve.

The lines were successfully bled and the gate was opened sufficiently to deliver an ample water supply to the farms dependent on Pleasant Valley Reservoir in 1950. Thus what seemed to be an insurmountable predicament was overcome by one man's ingenuity. The End.

"IT GAVE ME AN EERIE FEELING," said Mr. Johnston, to know he was so far under water, and hearing the echo of every sound as he renovated the outlet works of the Pleasant Valley Dam.

Drawing by Lloyd Chellman, Graphics Section, Washington, D. C., based on cross-section diagrams obtained through the courtesy of the Idaho State Reclamation Engineer.



SAVING THE SOIL—at left, three rock check dams, constructed from material available at the site, hold back streams that run rampant after heavy rains. Below, brush check dams which retain material washed down the gullies. Both are vital parts of the erosion control program in the Keswick reservoir and watershed area. *Photos by J. D. Leeper, Region 2, photographer.*

EROSION CONTROL at Shasta and Keswick

by LOUIS G. TEMPLE, Landscape Architect
Shasta Dam, Calif.
Region 2 (Headquarters at Sacramento, Calif.)

CONTROL OF SOIL EROSION, which has been a world-wide problem for ages, is being tackled with vigor by Bureau of Reclamation crews on the Keswick Reservoir watershed in northern California, where heavy rainfall and lack of vegetation have combined to seriously threaten the useful life of the reservoir.

In attacking this problem, as a part of the Bureau's soil and moisture conservation program, Reclamation crews not only are saving thousands of tons of soil, but in the words of Patrick Henry, they are being patriotic.

Most Americans are familiar with his famous statement, "give me liberty or give me death," but very few knew that this great Revolutionary War figure also defined a patriot as "the man who stops the most gullies."

Ample opportunity exists for the crewmen to qualify under this definition of patriotism, for the hills surrounding both Keswick and Shasta Reservoirs are literally being washed away by rainfall, coursing through deep gullies.

From the turn of the century until about 1925, acrid fumes from smelters located in the Sacramento River canyon north of Redding, Calif., practically denuded the watersheds.

The average annual rainfall in this area is about 62 inches, with 100 or more inches not uncommon, and nearly all of this rainfall occurs during the winter months.

Since the advent of the smelters, the steep watersheds have been literally gutted by water erosion, carrying hundreds of thousands, if not millions, of tons of soil into the Sacramento River. Prior to the construction of Shasta and Keswick Dams, annual flooding of the Sacramento River sluiced the eroded soil through the canyon and on down the valley. Now, due to an extensive erosion control program, this eroded soil remains in place.

Natural recovery of vegetation on these watersheds ranges from very poor in the totally denuded areas, to moderately good in the less devastated

areas. However, the gullies continue to grow deeper and wider, undercutting much of the natural vegetation, even in the better section.

Keswick Dam, located approximately 7 miles downstream from majestic Shasta Dam, forms a comparatively small, shallow reservoir for re-regulating water released from Shasta Dam. A three-unit power plant of 75,000-kilowatt capacity is located at Keswick Dam.

The relatively small capacity of the Keswick Reservoir, plus the semibarren and badly eroded watersheds, created a serious problem. A method of holding the soil on the watersheds had to be found in order to prolong the life of the reservoir and powerplant. After 3 years of investigation and experimental work, a three-phase plan was adopted.

(*a*) Construct a series of inexpensive check dams in all gullies, extending from the reservoir to the upper slopes of the watersheds, using whatever material available at the dam sites, such as rocks, logs, and brush.

(*b*) Establish broadleaf native plant material around the check dams and on all denuded areas.

(*c*) Reforest the area by planting Ponderosa and Jeffrey pine seedlings on the watersheds.

Actual work on this three-phase plan was started in December 1949 and the plan has since proven highly successful.

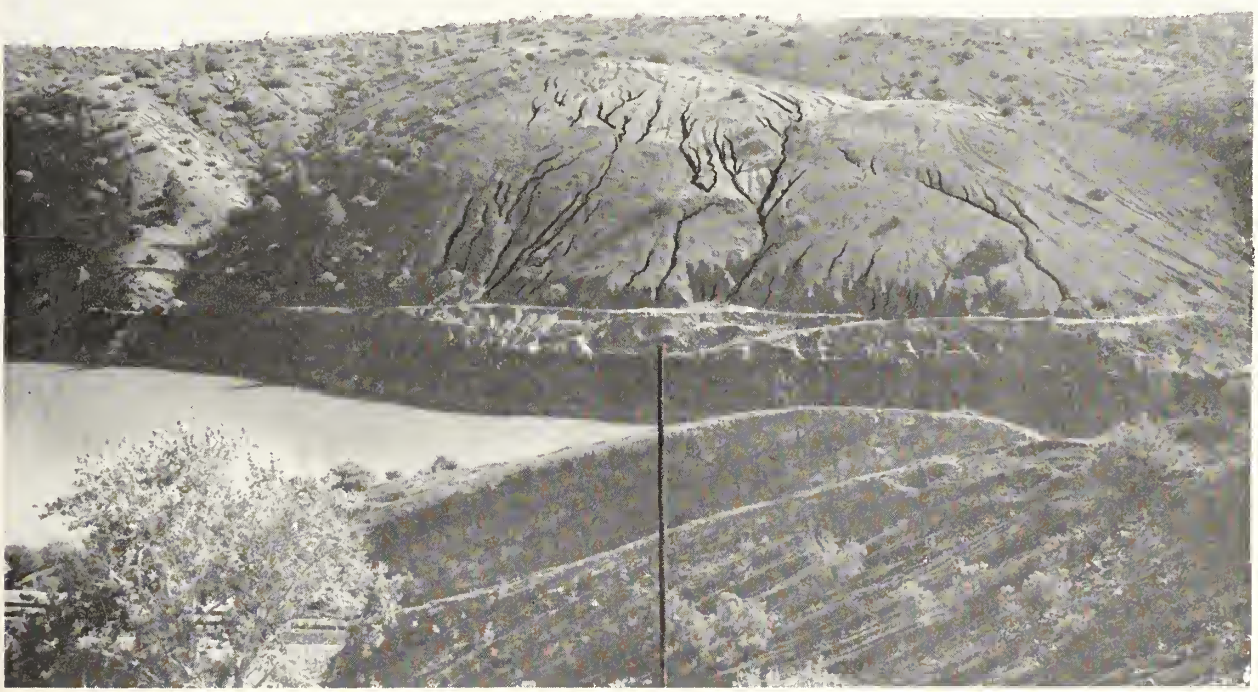
Usefulness of the check dams does not cease when the reservoirs behind the dams become filled with eroded soil. Instead, they act as steps, letting the water down the steep slopes in easy stages, with each step breaking the velocity of the stream. The broadleaf native shrubs planted at each check dam will eventually form living barriers, increasing the efficiency of the dams.

By the beginning of October this year, the crews in the Keswick Reservoir watershed had built 50,000 check dams. In addition, they had planted nearly a million acorns, over 100,000 broadleaf plants, and a half a million Ponderosa and Jeffrey pine tree seedlings.

The check dams alone, according to estimate, have prevented approximately 7,500 cubic yards of silt from being carried into the Keswick Reservoir.

This work has been in progress for about three years and two more years will be needed to complete the program. THE END.

LOSING THE SOIL. This view of an uncontrolled area around the Keswick reservoir shows deep gullies caused by streams from heavy rains. Eventually, shrubbery will hold the soil on these hillsides and protect the reservoir from tons of soil and debris washed down by these streams. *Photo by J. D. Leeper, Region 2 photographer.*



Free —

In the early days of Federal Reclamation, settlers on new projects took 5 to 10 years to bring their farms under irrigation. No man had the facilities to transform his sagebrush land into a fully irrigated farm in a single season.

More recently, with modern machinery and improved methods, new farmers on western reclamation projects have set a much faster pace, oftentimes bringing their holdings under cultivation in the matter of a few months.

But what will be a world's record in the transformation of a piece of dry sagebrush land into a fully developed farm will be set next year on the Columbia Basin project in eastern Washington. There, in a single day, 80 acres of land will be cleared and leveled, the crops planted, the distribution system put in, the fences erected, a three-bedroom house constructed and fully furnished, all of the outbuildings built, farm machinery moved on, and livestock and poultry provided.

The stunt, known as a "Farm-in-a-day" or "Dawn-to-Dusk" operation, is a highlight of a 5-day celebration that the State of Washington is staging to herald the initial delivery of water to the first of a million acres of irrigable land. A committee, appointed by Gov. Arthur B. Langlie, has planned a program that is scheduled to be one of the greatest public celebrations ever held in the West. It will also feature pageants, water follies, carnivals, dancing, a mass church spectacle, and dozens of other spectacular events.

The farm, worth $50,000, will be given away free to the most worthy veteran in the United States in recognition of the contributions the soldiers of America have made toward the molding of the national solidarity that makes projects like the Columbia Basin development possible. The awarding of the prize to this veteran involves a Nation-wide search, now being conducted by the Veterans of Foreign Wars through posts in every city and hamlet in the United States.

Any veteran of World War II or the Korean war is eligible to receive the farm. All he has to do is to get the rules and regulations from his local V. F. W. post or national headquarters at Broadway and Thirty-fourth Street, Kansas City, Mo., and submit a statement outlining why he thinks he deserves to get the farm.

No fancy writing is required. He should stress his status in the war and in civilian life, with special emphasis on any unusual circumstances that he feels warrants consideration. The veteran selected will play a key role in the ceremonies at which the first water for the Columbia Basin project is delivered.

The case of the most deserving veteran from

A $50,000 IRRIGATED FARM

FOR THE NATION'S MOST WORTHY VETERAN. Waste land like that on the opposite page will be transformed into a productive farm like the one above as a highlight of the celebration marking the initial delivery of water to the million-acre Columbia Basin project next year. The Bureau's predevelopment farm, above, is near the site of this "Farm-in-a-Day" program. *Photo on opposite page by F. B. Pomeroy, photo above by A. W. Bauman; both are Region 1 photographers.*

each of the posts will be judged by a State board of judges and the case of the most deserving veterans in each of the States will then be judged by a national board of judges, which will select the winner.

In an effort to prevent overlooking the most deserving veteran, Hubert Walter, chairman of the Columbia Basin Celebration Committee, asked readers of the RECLAMATION ERA to help the V. F. W. find this person.

"We suspect that some of the most worthy veterans will be shy about entering their names in the search," Walter said. "Therefore, we hope that people reading this article who know of deserving cases will help these veterans get their rules and regulations and enter their statements. We want to find the person about whom everyone will say, 'Isn't that swell? That guy sure deserves a break.'"

While only one $50,000 irrigated farm is available through this celebration, the Bureau of Reclamation will offer to other veterans new opportunities to undertake irrigated farming on several projects during the next few years. These are listed at right. Anyone wishing to get an application form to apply for these lands should write to the office shown. Also see pages 288 and 289 of this issue for 1951 opportunities.

1952

FOR SALE—80 units, comprising 4,610 acres, on the Columbia Basin project, Washington. January and February 1952. *Write to Ephrata, Wash.*

HOMESTEADING—11 units, comprising 887 acres, on the Coachella project, California. June 1952. *Write to Boulder City, Nev.*

30 units, comprising 3,900 acres, on the Riverton project, Wyoming. June 1952. *Write to Billings, Mont.*

1953 (tentative)

FOR SALE—9 units, comprising 1,300 acres, on the Gila project, Arizona. August 1952. *Write Boulder City, Nev.*

FOR SALE—37 units, comprising 2,823 acres, on the Columbia Basin project, Washington. January and February 1953. *Write to Ephrata, Wash.*

52 units, comprising 7,700 acres, on the Gila project, Arizona. October 1953. *Write to Boulder City, Nev.*

HOMESTEADING—8 units, comprising 640 acres, on the Coachella project, California. June 1953. *Write to Boulder City, Nev.*

25 units, comprising 4,215 acres on the Riverton project, Wyoming, and 6 units, comprising 720 acres, on the Shoshone project, Wyoming. February 1953. *Write to Billings, Mont.*

1954 (tentative)

FOR SALE—130 units, comprising 11,033 acres, on the Columbia Basin project, Washington. January and February 1954. *Write to Ephrata, Wash.*

23 units, comprising 3,500 acres, on the Gila project, Arizona. October 1954. *Write to Boulder City, Nev.*

HOMESTEADING—50 units, comprising 8,250 acres, on the Riverton project, Wyo. February 1954. *Write to Billings, Mont.*

Fighting Corrosion With Corrosion

(Continued from page 267)

guard the roller gates at Imperial Dam; graphite anodes are suspended in the reservoir. In addition, some of the Imperial bypass gates are protected by the galvanic method utilizing anodes of magnesium and zinc. The magnesium anodes are long magnesium wires embodying an iron wire core. This core holds the anode together until the magnesium has expended itself protecting these vital structures.

The upstream face of one 21- by 17½-foot radial gate is protected by ten 15-foot lengths of the magnesium anodes hung on the gate. The downstream face is protected by five 20-foot lengths hung horizontally. Six zinc anodes, strips 9 inches wide and one-sixteenth inch thick, are fastened vertically to the upstream face of another gate.

The effectiveness of this cathodic protection at Imperial Dam is measured through the use of small metal plates called "coupons." The coupons, widely used to predict the rate of corrosion, are removable plates of the same material as the metal structure and are exposed to the same corrosive conditions as the structure.

The test coupons removed from the Imperial Dam site installations reveal the magnitude of the savings that are possible through the use of cathodic protection techniques. J. R. Collopy, former Chief of the Operation and Maintenance Division of the Lower Colorado River District, who has spark-plugged this work, estimates that a saving of $36,000 a year will result over previous methods of maintenance. On the basis of square foot of metal protected, he estimates the annual cost of cathodic protection on these installations at less than 1 cent a year as contrasted to 8 cents a year for cleaning and repainting once every 5 years.

These savings are probably more than can be normally expected, as the Lower Colorado River water is warm and carries a considerable amount of dissolved salts—factors which aid the electrolytic process but which are exceptionally hard on paints. However, the Reclamation engineers consider cathodic protection holds promise of a general victory over the implacable foe of corrosion on certain types of structures. They believe that the expenditures which were formerly used to appease the ravages of corrosion can now be greatly reduced in the water users' budget. THE END.

Hells Canyon Report Sent to Congress

Secretary of the Interior Oscar L. Chapman on October 8 sent to the Congress a report on the Snake River Reclamation project in Idaho with a recommendation that the multipurpose Hells Canyon Dam be authorized as the initial phase of the development.

The Hells Canyon development is designed to add more than 1,400,000 kilowatts of prime power to the Columbia River system in an area where there is an acute power shortage for defense purposes. The Secretary also recommended that the initial authorization include the Scriver Creek power features of the Payette unit of the Mountain Home Division. In addition to the power features of this unit which amount to almost 100,000 kilowatts of generating capacity, the Payette unit of the Mountain Home division provides for the delivery of irrigation water to 192,000 acres of fertile desert land located between Boise and Mountain Home, Idaho. This latter development is not proposed for authorization at this time. •

Supplemental Funds Voted for Four New Dams

In the closing hours of the first session of the Eighty-second Congress, the lawmakers, in passing the first and second supplemental appropriation bills on October 20, 1951, made $5,285,000 available for construction on four new reclamation dams—Palisades, Kirwin, Jamestown, and one at Vermejo. All of the dams are multiple-purpose structures.

Congress appropriated $2,000,000 for the $76,601,000 Palisades Dam and Power Plant in Idaho in view of its importance as a potential producer of 114,000 kilowatts of hydroelectric power for defense and domestic use. The project will also supply supplemental water for about 650,000 acres of land. Preconstruction work has been done on the project in the past and the tunnel contract will be awarded this month.

Two of the dams are part of the flood-control system on the Missouri River. Some $2,500,000 was appropriated for Kirwin Dam, an $18,187,000 structure on the North Fork of the Solomon River near Kirwin in central Kansas, the area hit by floods last summer. Jamestown Dam on the James River in North Dakota received $500,000 for in-

COVER YOUR SIPHONS

From one of our subscribers, Mr. A. I. Myers of Caldwell, Idaho, came an interesting photo and letter the other day, pointing a moral to other reclamation farmers.

It seems that Mr. Myers, who owns land in the Black Canyon Irrigation District of the Boise Project, installed 10-inch cement irrigation siphons to improve the efficiency of his operations. One day a neighbor's full-grown bird dog was chasing a rabbit. The frightened animal, probably thinking that the siphon would be as safe as a hollow log, leaped into the pipe, where he became entangled in the joint of the second **L**. The dog, as is usual with many of his breed, must have underestimated his own size and went into the siphon after the rabbit—and met the same fate. Neither of them could get out of the siphon and before anyone discovered their plight they died.

When Mr. Myers learned of these circumstances, he "locked the barn door . . ." or more precisely, put a board gate on the outlet of the siphon, which will be there whenever the pipes are not in use. Aside from the humane angle of preventing other animals from suffering the same fate, this will keep the water flowing down the ditches. Fortunately, from the standpoint of water deliveries, the dog and the rabbit couldn't get any further than the joint of the second **L**. Had they been able to travel a few hundred feet into the siphon, it would have been quite a job to get the siphon opened up for use this spring. The animals had completely plugged the siphon, rendering it absolutely useless.

ANY SIMILARITY between Mr. Myers and the man in the drawing is unintentional and purely accidental. The drawing was based on the story, plus a photo of Mr. Myers kneeling beside the siphon with the dead rabbit and dog. Due to technical considerations, we substituted the above rendition by Lloyd Chellman of the Graphics Section, Washington, D. C., to graphically depict this problem.

ERA readers may remember Floyd Roush's article entitled, "Cover Your Siphon and Cut Costs" on page 247 of the December 1949 issue, in which he pointed out the wisdom of covering siphons during the winter months to avoid leaks due to cracks caused by cold weather, and also submitted a design for a cover with a "swinging door" feature for automatic opening and closing.

We welcome similar contributions from our readers which may help other irrigationists to solve the multitudinous problems of reclamation farming.

THE END.

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itial construction on a $10,628,000 project. It will provide 540,000 acre-feet of storage for initial use in flood control, and for municipal water. Irrigation features for both the Kirwin and Jamestown projects will be developed later.

An initial appropriation of $285,000 was made for the $2,664,000 Vermejo project to rehabilitate irrigation facilities for 7,200 acres of land near Maxwell in northeast New Mexico. The plan calls for enlarging three existing reservoirs and creating a new reservoir for flood and silt control, plus other repair works.

Chief Engineer L. N. McClellan is completing construction plans and issuing bid notices without delay so that contracts may be awarded and work started at the earliest possible date. •

HOW TUCUMCARI GREW

by WILLIS C. BOEGLI, Division of Operation and Maintenance, Region 5 Headquarters, Amarillo, Tex.

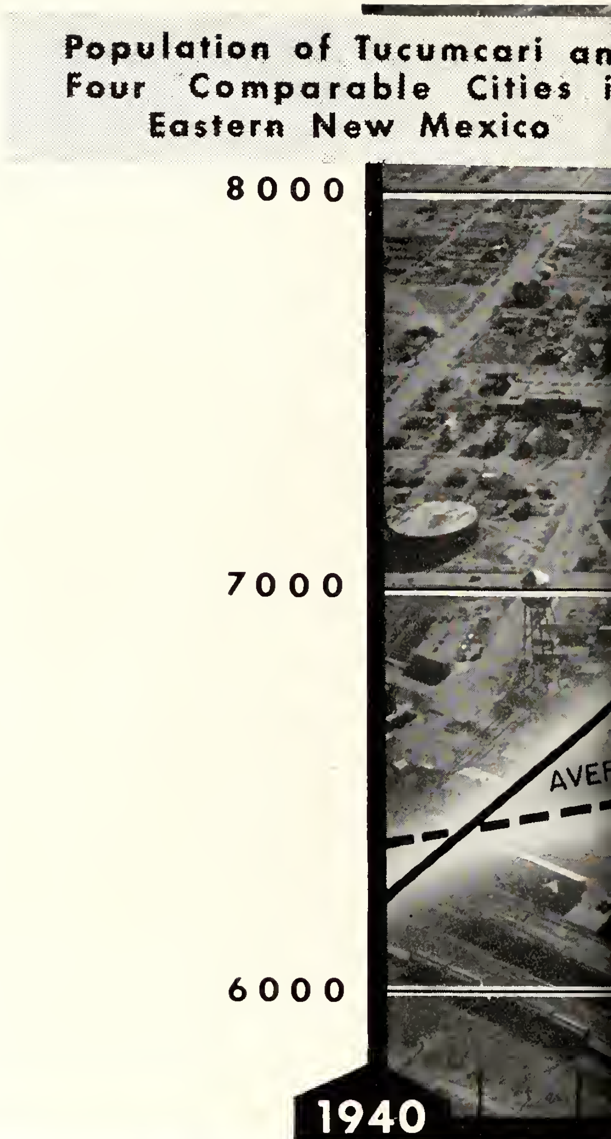
NEW MEXICO EXPERIENCED TWO BIG BOOMS in the middle 1940's. One boom, which occurred at Alamogordo, was activated by ignition of the world's first atomic bomb. The other boom, although far less spectacular, resulted from the Bureau-constructed irrigation project at Tucumcari.

Construction and settlement of the 42,000-acre irrigation project set off a continuing boom in the city of Tucumcari. This formerly small community, located on the dusty and drought-ridden cattle trails and wagon freight routes of the past, and on the railroads, airlines and highways of today, owes its recent growth primarily to the rapidly developing irrigation project that virtually surrounds it.

The Tucumcari irrigation project was launched in 1940, and the first irrigation water was delivered to a part of the area in 1946. Some measure of benefits that flowed into the city of Tucumcari as a result of the irrigation project is reflected in a study of the city's population and business gains as compared to what has happened in four comparable eastern New Mexico cities with such similar economic factors as rail and highway transportation facilities and characteristics of trade areas.

Tucumcari's population increased 35 percent in the last 10 years while the comparable cities gained an average of only 6.4 percent (see graph). The irrigation community's gain was also accompanied by a substantial increase in business activities.

Tucumcari's assessed valuation trebled in the period between 1940 and 1950. Postal receipts, building permits and utility connections more than doubled in the same 10-year span. Business activities, which appear to be directly the result of the irrigation project, created over $5,000,000 in bank deposits and $781,000 annually in new construction in the 1940 to 1950 period. This growth, resulting from the irrigation project, also is reflected in a million dollar expansion in public utilities and city construction to accommodate the city's population increase.



Department of Commerce Business Census reports for 1939 to 1948 show a much greater increase in Tucumcari's business activities than in any of the other four comparable New Mexico cities. The annual payroll for wholesale trades in Tucumcari was 726 percent greater and the number of wholesale establishments 650 percent greater than the average for the other cities studied. Fifty-two new retail businesses were established in Tucumcari during the 1939–48 period while the other

comparable cities showed a loss in some retail business activities. The number of persons employed in retail trade in Tucumcari increased 198 percent over comparable cities.

These figures do not reflect the complete story of Tucumcari's progress by virtue of the irrigation project, for considerable expansion in all phases of trade has occurred since 1948 when the business census data were tabulated.

Crops produced on the Tucumcari project in 1949 and 1950 had an average value of more than $1,000,000. Under full project development, crop and livestock values are expected to total about $4,000,000 annually in an area that once could sustain but a few head of cattle during the summer months.

The city of Tucumcari is a part of the Arch Hurley Conservancy District, which has contracted to repay the reimbursable part of the project construction cost. Nonirrigated land in the District, including city property, will repay 20 percent of the District's obligations. Those increases in business activities in Tucumcari, for which the irrigation project is directly responsible, appear to justify the Conservancy District's plan of project repayment under which urban properties repay substantial part of the project's cost.

THE END.

IN POPULATION AND PROSPERITY. In 10 years, as indicated on the chart at left (superimposed over an aerial view of the fast-growing town in New Mexico) Tucumcari topped four cities in the State. Below, two new farm homes, typical of those on the project. *Aerial photo by Dale Hovey, former Region 5 photographer; photos below by Fred Finch, Region 5 photographer.*

GOODBYE TO SUCKERS, like the one being displayed, an enemy of game fish. *Yakima Morning Herald* photo.

ROTENONE AT BUMPING LAKE

by EARL L. SMITH, Engineer-Hydrographer, Yakima Project, Washington, Region 1 (Headquarters at Boise, Idaho)

A STRANGE SIGHT MET THE EYE one cold, gray, early morning last fall on Bumping Reservoir, in the heart of the Cascade Mountains.

Twenty-seven boats, driven by outboard motors, pulling full gunny sacks through the water, isn't something you see every day.

One hiker along the shore, looking at a boat, was heard to mutter, "For the love of mud, what are those two guys doing?"

But those "guys" knew what they were up to. So did the other 52 individuals similarly riding around in boats over other parts of the lake. They were part of a scrap fish eradication crew hired by the Washington State Game Department to spread rotenone in the water to rid this important Yakima project reservoir of suckers, squawfish, and shiners which had driven trout and other favorite sporting fish from the lake.

Today there are 600,000 small trout swimming to their heart's content and unmolested in the cold blue water, planted there by the game department to make this beautiful lake, set like a blue jewel amidst the white, snow-covered crags of the rugged Cascades, the popular recreational area it once was. The operation points to the significance which professional fish and game people attached to Federal Reclamation reservoirs in the Pacific Northwest as outdoor playgrounds for the area's growing population.

The Bumping Lake program is said to be the largest single scrap fish eradication program ever undertaken anywhere in the world. Actual operations began about August 3, when the Bureau of Reclamation began emptying the lake so that a minimum amount of the poison would be required. When full the 4-mile-long lake, which has a surface area of 1,300 acres, contains 62,600 acre-feet of water. When the actual poisoning began in late September, it had been drawn down to 32,510 acre-feet, or roughly 10½ billion gallons.

Robert Rennie, District Fish Biologist, estimated that this quantity of water would require about 43,000 pounds of 5.5-percent rotenone, which was ordered and delivered to Bumping.

An outdoor kitchen was set up to feed the crews who were to help with the poisoning. But as Bumping Lake in the fall is whipped by storms swirling around the high peaks, the weather forced moving the tables inside a summer cabin furnished by Jack Nelson, retired gate tender at Bumping Lake. (See RECLAMATION ERA, December 1946.) He also furnished sleeping accommodations.

The morning before the spreading of rotenone in the lake, two transit-mix concrete trucks arrived at Bumping to mix the material. Each truck was charged with 2,000 pounds of dry rotenone dust and approximately 220 gallons of water. This was just enough water to settle the dust and it caused the rotenone to expand to nearly three times its original bulk.

The mixed rotenone was put in loosely woven gunny sacks, about 1,500 of them, and taken by boat to the shoreline opposite each of 37 sections into which the 659-acre lake had been marked. Markers consisted of large 4-foot black and white numbers on the banks, and bright yellow 5-gallon cans on the lake surface, anchored in place.

The morning of operation rotenone, after a hot breakfast prepared by an eight-man kitchen crew, each two-man team was given a map of the lake showing the sections they were to cover. The poison was spread by dragging the gunny sacks behind an outboard motor boat. The motor was tilted up slightly so as to drive the water against the sack, thereby beating the rotenone out into the water at a much faster rate. Each crew crossed

CLEARING OUT THE SCRAP FISH. At left, above, members of the task force at Bumping Lake gather for instructions and equipment. At upper right, loading a few of the 15,000 gunny-sacks full of rotenone. Above, dragging the poison through the water. *Two photos at right through the courtesy of the Yakima Morning Herald. Photo at upper left by the author.*

and recrossed its sections in checkerboard fashion, until the allotted number of sacks of rotenone had been distributed throughout each section in proportion to the depth of the water.

A flotilla of 27 outboard-motor boats was used in spreading operations. Two boats went up Bumping River and small streams entering the lake, while 24 other boats covered the lake proper. One boat was used by Rennie in supervising the job. Small potholes left by lowering the lake were poisoned by hand or wading.

The actual poisoning began about 8 a. m., and the small suckers, squawfish, and shiners in the shallow water surfaced shortly thereafter. Since the rotenone settles about 8 feet per hour, it was nearly noon before many silvers appeared. Huge, ugly suckers, some weighing up to 10 pounds, floated on the surface. Fifty squawfish and shiners were counted within an area no larger than a table top.

The poison affects the gills, causing the fish to die for lack of oxygen. Only marine life having gills is affected by the rotenone. It is believed that only a part of the fish surfaced, as many were seen on the bottom in 8 to 10 feet of water during the morning following the poisoning.

Most of the larger scrap fish and silvers were dead the day following the poisoning and the last live fish seen was a sucker "in distress" the second day after. Since there was no sign of life in the lake subsequently, the kill was said to "look favorable." Only a few rainbows, cutthroats, and Dolly Vardens—popular game fish—were seen.

The outlet gates at Bumping Lake were to be kept closed for approximately 60 days to allow the rotenone to lose its toxicity. However, irrigation needs made it necessary to lift the gates in 50 days at which time the water was still toxic and fish in the lower Bumping River (approximately 12 miles long) were killed.

Because of the planting of 600,000 small trout in the lake, the Fish and Game Department has closed the reservoir to fishing this year. It will be opened at some later date, when the Game Department decides that the fish planted have grown large enough.

THE END.

MECHANICAL SIPHON PRIMER

by

LARRY SWARNER, Agricultural Engineer,
Region 1 Headquarters, Boise, Idaho

TO KEEP HIS HANDS AND KNEES DRY, Deschutes project farmer Warren A. Snapp devised the siphon primer which he is holding, above, and demonstrating in the other pictures. As you see, Snapp's device is really a "snap." *Photos by Marvin N. Shearer, Assistant County Agent, Jefferson County, Oreg.*

The adage that necessity is the mother of invention has been demonstrated once more on the North Unit of the Deschutes project in Oregon. Here, Mr. Warren A. Snapp, who has farmed 120 acres for the past 2 years on the Agency Plains, has perfected a mechanical device to prime irrigation siphon tubes.

Numerous methods are employed to start small siphon tubes. Probably the most common is to submerge the tube in the irrigation ditch, thus removing the air from the tube. With one hand placed tightly over one end of the tube, it is then drawn over the ditch bank. The flow is commenced when the hand is removed from the end of the siphon tube.

Another method which requires a little practice is to place the tube in the irrigation ditch with the outer side of the curve of the tube toward the irrigation. With one hand, give the tube a circular "flip," which brings the one end over the bank of the ditch, with the other end under water at all times. The centrifugal force set up by the

circular motion forces water out of the discharge end of the tube, thus creating the siphon action. This method enables an irrigator to start the tube with one hand while using the other arm to carry siphon tubes.

Still another method in common usage is the method of "pumping" the siphon tube. The irrigator stands on the ditch bank with the siphon tube in one hand. With a quick action, he forces the empty tube downward into the water. As he brings the tube upward, his hand is placed tightly over the upper end of the tube. This quick action is repeated with the hand removed from the end of the tube on the downward thrust and closed tightly on the upward thrust. With a little practice, it is possible to start the siphon tube by this pumping action in two downward and two upward thrusts.

Mr. Snapp tried all of these methods but he disliked getting his hands and knees wet, especially on the cold mornings when it was necessary to change his irrigation water. He had considerable difficulty in starting his siphon tubes to irrigate his 100 acres of ladino clover and 20 acres of intermediate wheat grass without experiencing the painful effects of chapped hands. The use of rubber gloves or other materials to keep the water off his hands was entirely unsatisfactory. His chapped hands became so sore that after trying all the concoctions for curing chapped hands carried by the local drug store, he was still unable to sleep at night because of the intense pain.

While lying awake at night, Snapp's mind naturally began to figure out some devices which could be used to start the siphon tubes without getting his hands in the water. It was during one of these wakeful periods that he thought out the useful mechanical device for which he has applied for a patent.

This mechanical device makes use of two levers as illustrated in the above picture. One lever grasps the siphon tube at one end in order that it may be moved into the ditch and out over the ditch bank. The second lever is used to press a sponge rubber ball firmly against the end of the siphon tube after the air has been expelled from the tube by means of the water in the supply ditch. The one end of the siphon tube is then moved out over the ditch bank into its proper place and the sponge ball is released by means of the second lever allowing the siphon tube to flow.

Mr. Snapp, who is always working on some device to make farm work more enjoyable, points out that in addition to keeping one's hands out of the water, the device also enables one to set siphon tubes on soft, wet banks which have not become firm. It also makes it unnecessary for a farmer to stoop down on his knees in mud and water and he states that he can set more siphon tubes with his mechanical device in a given length of time than he can by using his hands.

"It's not only the time saved," says Mr. Snapp, "but it also turns an unpleasant job into an enjoyable task." THE END.

For another interesting idea on siphon tubes read the article entitled, "Bill Ebbs' Siphon Primer" on page 229 of the October 1949 issue of the RECLAMATION ERA.

Municipal Power Contracts Standardized

Secretary of the Interior Oscar L. Chapman has approved a standard contract article on resale rates for power obtained from Federal projects by municipalities. This resale rate clause is expected to facilitate the sale of power to municipal systems and at the same time preserve the objective of maintaining the lowest possible rates in order to encourage the widespread and abundant use of electricity. Municipalities have been among the customers extended a preference by law since the early days of Federal development of the water resources of the Nation.

The standard clause is applicable to future contracts of the Southwestern Power Administration and the Southeastern Power Administration as well as the Bureau of Reclamation which operates in the Western States alone, where 31 municipalities are customers of the Bureau, exclusive of those in the Pacific Northwest who are serviced with Grand Coulee Dam power via the Bonneville Power Administration. During 1950 these municipalities purchased 2,832,348,824 kilowatt-hours of energy from the Bureau. The average cost varied per killowatt-hour from 2.57 mills from large power plants to 9.40 mills from small power plants. Even at these low rates, which extended the benefits of low-cost Federal power to hundreds of thousands of western people, the municipalities paid into the Government $5,118,095 to be applied on operation and maintenance of the plants and retirement of the Federal investment in these facilities. •

SHORT CUTS TO WEED KILLING CALCULATIONS

PART 7. How to Prepare Weed Killers for Woody Plants

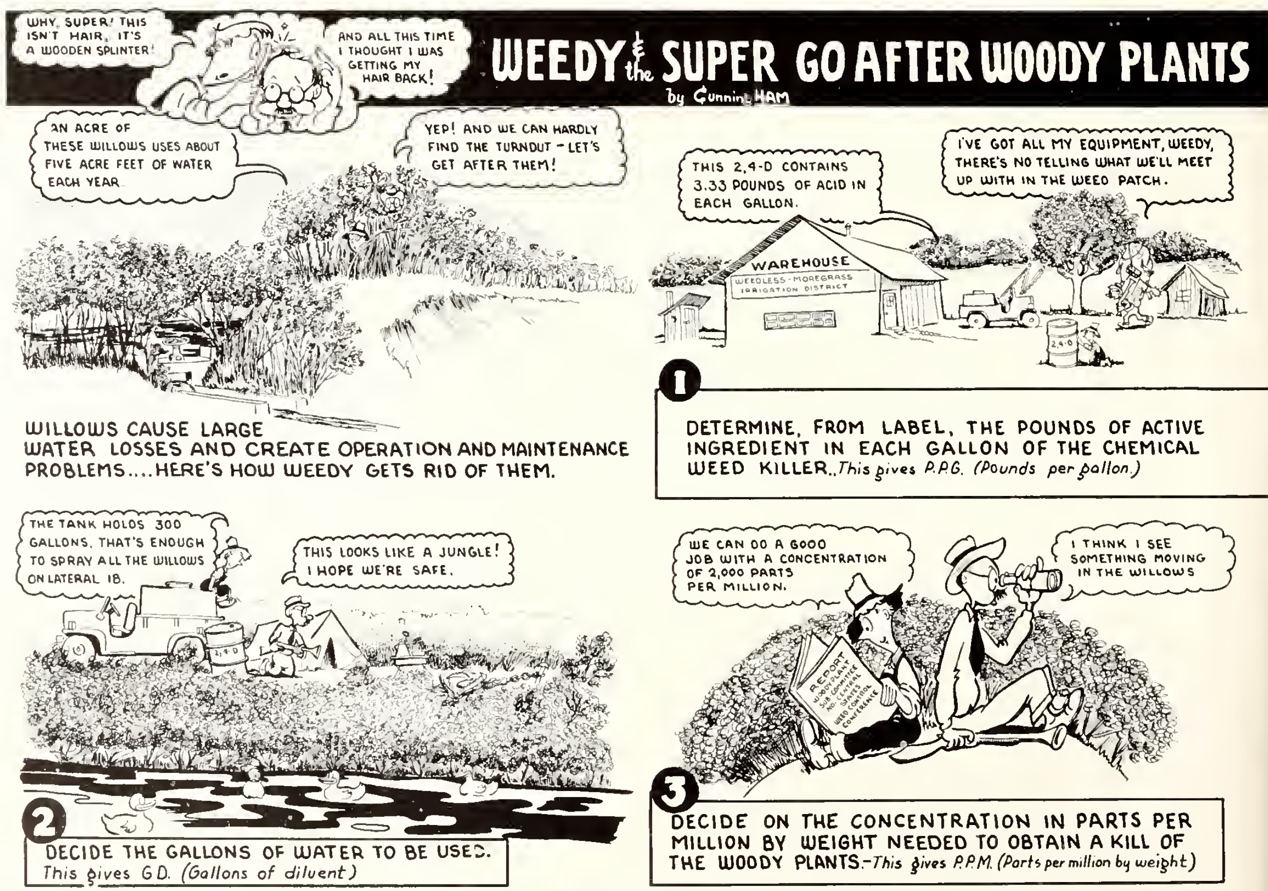
by JOHN T. MALETIC, Weed Specialist and Soil Scientist, Region 7 Headquarters, Denver, Colo.

Noxious woody plant eradication in the United States costs millions of dollars each year. These plants cause expensive maintenance problems on irrigation systems, along highways, power lines, railroads, and drainage ditches. Above and on irrigation systems they use annually a large amount of water needed for irrigation. Expensive mechanical methods to control woody plants, such as willows, salt cedar, mesquite, poison oak, poison ivy, ribes, and cottonwood are being replaced by less expensive chemical methods. The chemicals, 2,4-D and 2,4,5-T effectively control these and other woody plants.

If woody plants trouble you, get rid of them. Follow Weedy's instructions in the cartoon below. Do the job right. Select the proper chemical. Get the right concentration for the weed killer solution. Be sure the chemical and the concentration are suitable for your problem.

Use the chart on the opposite page. It will help you make the solution you need. First prepare the solution. Next drench the leaves with it. You do not have to calibrate the rig for spraying woody plants. But when short growing annual and perennial weeds are sprayed, calibration is needed to put a given poundage of chemical on each acre. (See parts 4, 5, and 6 of this series for the method of preparing solutions for this type of application.)

Remember—control of woody plants costs less if you treat when the plants are small.

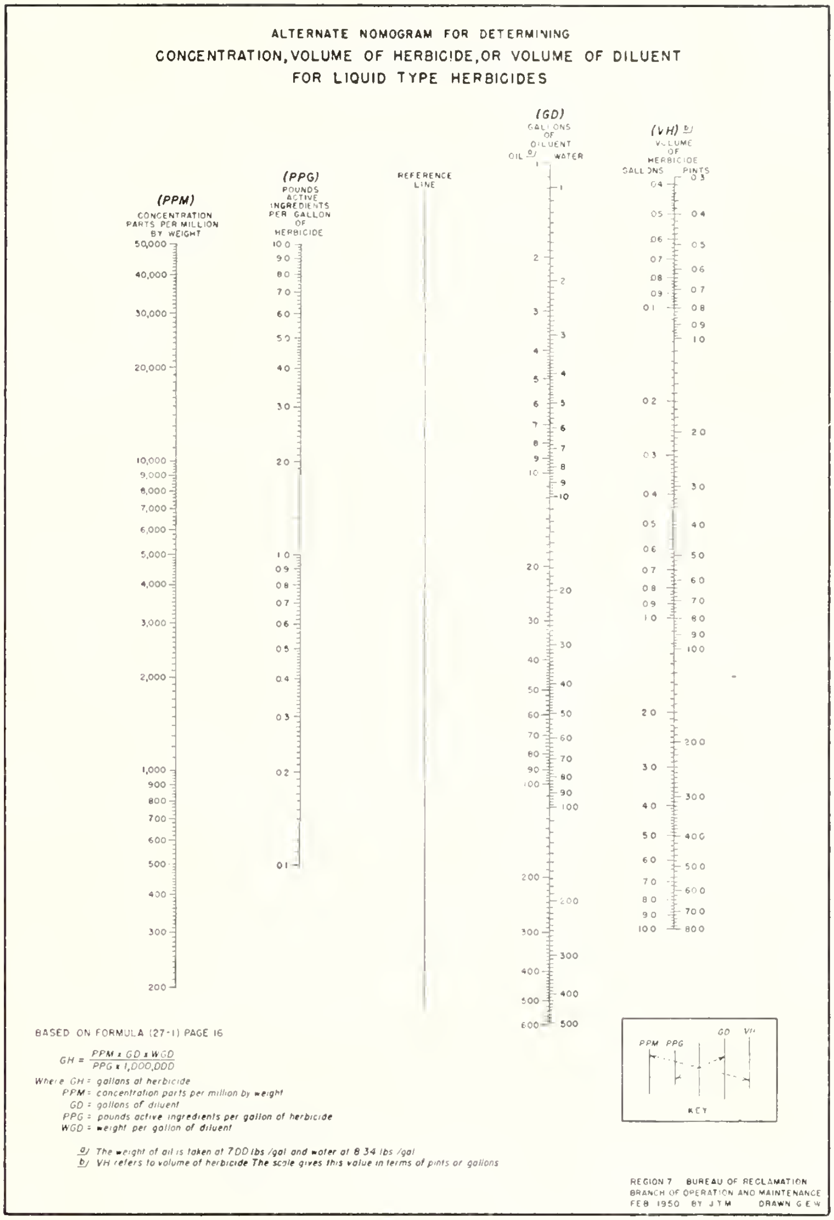


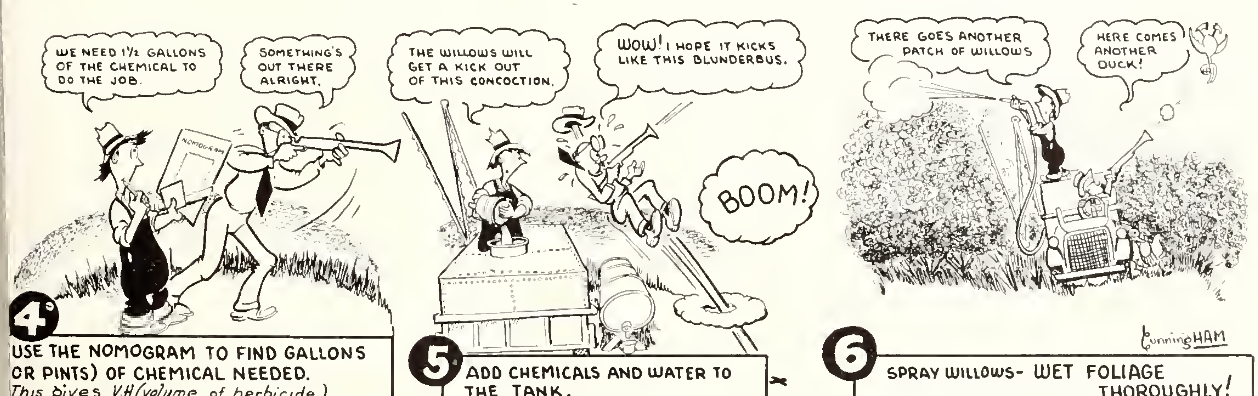
INSTRUCTIONS AND EXAMPLES

Use this chart to solve your weed killer mixing problem when you go after woody plants with liquid chemicals. The key in the lower right-hand corner shows how to use the chart. Connect the scales with a transparent straightedge. Note that the GD scale is graduated for both water and oil. The VH scale gives the answer in gallons or pints.

MESQUITE. For the control of mesquite by spraying freshly cut stumps, a solution containing 10,000 p. p. m. 2,4,5-T acid in diesel oil is recommended. If the product to be used is a 2,4,5-T ester containing 3.34 pounds 2,4,5-T acid per gallon—how much should be added to 10 gallons of oil to get the needed concentration? Connect 3.34 PPG with 10 gallons of oil on GD. Mark the point where straightedge crosses reference line. Connect point with 10,000 p. p. m. Read answer: 1.7 pints or 0.21 gallons on VH scale.

WILLOWS. To control willows, a solution containing 2,000 p. p. m. of 2,4-D acid was recommended. If a 2,4-D ester containing 3.33 pounds acid per gallon is used—how much chemical must be mixed with 300 gallons of water to get the concentration wanted? Connect 3.33 PPG with 300 gallons of water on GD. Mark the point where the straightedge crosses the reference line. Connect point with 2,000 p. p. m. Read answer: 12 pints or 1.5 gallons on VH.





Reclamation's Golden Jubilee

(Continued from page 265)

ber that the great growth and ever-expanding worth of Reclamation have come about precisely because its fundamentals did not change. Like our own dams, Reclamation rests upon tested, sound, permanent foundations. If these foundations collapse, the structure they support will not remain intact.

Reclamation had an outstanding year, constructionwise. During the past few months, water gushed for the first time from the world's greatest pumps at Grand Coulee, from the world's second-greatest pumps at Tracy, and from a third tremendous pumping plant at Granby, Colo. These three pumping installations all within 6 weeks began pouring water on developments which will eventually increase by one-half the total acreage irrigated by Reclamation in its previous 50 years of existence.

Within the 1951 fiscal year, 534,893 acres were furnished with new water supplies, bringing our total Reclamation acreage to well over 6 million. Also, 771,000 kilowatts of power capacity were added. On September 14 of this year the last remaining generating unit at the Grand Coulee power plant went on the line, thus increasing the rated capacity of Bureau plants to 4,047,500 kilowatts. The actual capability of the plants, however, considerably exceeds this figure, and aggregate peak output has already passed 4¼ million kilowatts.

Four dams were completed—Bonny, Cedar Bluff, North Coulee, and Dickinson. Three more giants—Boysen, Canyon Ferry, and Hungry Horse—loomed higher in their canyons. The Colorado-Big Thompson drew nearer to the finishing line, set at 1953. Thanks to the rehabilitation and betterment program, our irrigation systems were in better shape than at any time since the end of the war. We have continued to turn projects over to the water users—last year saw the Balmorhea and Mirage Flats projects, the Midvale District of the Riverton project, and parts of the Yuma project thus come of age. Let those who fear we may invade States' rights with excessive Federal control take note. Reclamation has and does insist on relinquishing control and turning operations over to the water users.

Reclamation extended its foreign contacts, adding its very considerable resources of technical knowledge to the world-wide effort to relieve the people of the globe—including our own—from the burdens caused by the want of millions. Though we receive many and various benefits from these foreign activities, both directly and indirectly, none of the costs are charged to the domestic Reclamation program, or are taken from the Reclamation appropriations. These are paid by the foreign governments concerned or by American foreign-assistance agencies, which more and more are coming to realize that American Reclamation is one of the most productive, most famous, and most welcome forms of aid at their disposal. We support our approved international program, but we do not

RECLAMATION GOES GLOBAL is the subject of a meeting of U. S. and South American officials in Ecuador's Capitol. From the left are U. S. Ambassador Paul C. Daniels; Ecuadoran Minister of Public Works, Atahulpa Ruiz; President Galo Plaza of Ecuador and U. S. Commissioner of Reclamation Michael W. Straus. As part of the American Technical Aid program overseas in which demands for irrigation advice are giving Reclamation a leading role, William H. Farmer of the Bureau's Yakima, Washington, staff has been making a survey of water developments for the State Department in Ecuador. President Plaza has taken a personal interest in the program and discussed it with Commissioner Straus who stopped at Quito en route to lecture before many South American officials at the United Nations F. A. O. Latin American Center Conference in Santiago, Chile, in November.

want Reclamation skills and know-how to become a prize for export only. It will not, while we do not divert any of our domestic appropriations to overseas endeavor. Furthermore, the technical experience gained from overseas jobs will help us do a better job at home.

But as Reclamation has moved ahead, so have the years, and so have western needs. Viewing this annual report to you from a longer perspective, we see that there is one more fundamental fact about our movement which has not changed—the Reclamation program still is not meeting the demands for water or power in a single one of the 17 Western States in which it operates.

Our population continues to increase at the rate of 2,000,000 a year, authorizations or no authorizations. We have not been able to fill the generator seats in our power plants fast enough to keep up with power needs. Now we are running out of seats, and it takes years to build new ones. These needs for water and power extend all over the West. And Reclamation is ready and able to provide water and power wherever possible under Reclamation law, once the authorizations and appropriations are available.

During this defense emergency we must be constantly alert for new problems affecting Reclamation. The distinct outlines of what could become a particularly critical one are already on the horizon. Hungry industrial and commercial consumers of electrical energy desire Reclamation to pull the switches on irrigation pumps and forego watering the land as a result of the growing shortage of power. We have already feinted off one effort to divert power from the pumping of irrigation water for the Columbia Basin project, and can expect others elsewhere. Power for Reclamation pumping means production of more food and fiber for defense—resources indispensable to the defense mobilization program. Furthermore, Reclamation laws are very specific that irrigation has first call on the power generated at Reclamation dams. Some people don't know that, but the type on that page of law is large enough for your Commissioner to read without his bifocals.

Our cause is one which can build farm communities and cities and send trade to the far corners of the earth. The West is full of living, thriving proofs of its creative worth. But there are still many western communities where Reclamation has not yet brought the water and power for life and growth and true national strength. Whole regions still await the touch of the magic wand of Reclamation to awaken them from an age-old sleep so they, too, can contribute to the production and defense of our country. THE END.

First International Science-Service Agreement Signed

Secretary of the Interior Oscar L. Chapman on October 2 announced the signing of an agreement between the Governments of India and the United States whereby the Bureau of Reclamation will furnish advice and scientific and technical engineering service to the Government of India. This assistance will be given to the Indian Government in the United States only and will be paid for by India in advance of its actual performance.

A. N. Khosla, India's Chairman of the Water and Power Commission, conferred with Secretary Chapman and Reclamation Commissioner Straus on the operations under the agreement, which was completed with the aid and advice of the Department of State.

Under the arrangement Reclamation personnel and laboratory facilities at the Denver Federal Engineering Center will be available to assist the Indian Government with water development problems. The services will include the study and analysis of technical scientific data, testing material for dams, analyses of stresses and stability, and construction and testing of hydraulic models.

Service will be extended to the Indian Government only when it does not interfere with the domestic Federal multipurpose water conservation program in the United States. •

Feeding Salt to Livestock

(Continued from page 269)

feeding value occurs largely as a result of the great decrease in protein and phosphorus accompanied by a marked reduction in the volume of palatable and nutritious forage.

Thus it is that cottonseed meal with its high protein and phosphorus content has served to supplement dry weathered grass and browse. Mixed in from 2 to 4 parts of meal to 1 of salt, depending upon the amount of meal needed, and made accessible for regular dairy consumption, it at least provides sustaining nourishment.

There is no need to restrict the supplement to cottonseed meal alone. Under poor dry-range conditions it is believed that the rumen contents are lacking in the necessary nutrients for fermentation processes to function normally, and the welfare of the animal becomes impaired. This condition is being approached with apparent beneficial results by incorporating alfalfa meal and grain with the salt and meal. Molasses and trace minerals can be introduced if desired and the facilities permit. According to conjecture, the addition of these nourishing feeds in varying proportions to replace a part of the cottonseed meal stimulates the micro-organism activity of the rumen and makes for more efficient use of the available range feed.

Salt consumed in excess amounts can be fatal to livestock. Fortunately, in this regard cattle are highly tolerant to above normal levels of salt intake. Considerable speculation concerning the subsequent effect on the animal of continued digestion of excess salt led to a study of this problem by the University of Arizona. Tests revealed that cows digested (the technical term is "ingested") 1 pound of salt daily on a maintenance ration throughout 7 months of a pregnancy cycle without adverse effects. It was found that high salt intake must be accompanied with a corresponding increase of water consumption. A relatively small amount of salt can be fatal if water is restricted. It is not unlikely that this unnatural use of salt could be attended with adverse effects under certain conditions that have not as yet been investigated.

Care should be taken to avoid changing cattle suddenly from a straight feed supplement to a salt-feed mixture. Very hungry cattle may overeat at first if their supply is not regulated.

Salt-feed mixtures containing 33⅓ percent in loose and pellet form are widely fed in the range country. Stockmen can mix combinations of their own choice or rely on commercially prepared mixtures. Local range or pasture conditions will necessarily determine the particular mixture to feed.

A 30 to 33⅓ percent salt content is about the maximum amount to produce the right inhibiting effect and still allow sufficient intake of the feed portion. Reduction of the salt level from 33⅓ to 25 percent has effected an increase of practically 50 percent consumption in some range areas, according to reliable reports.

Self-feeding with salt as the control agent recommends this practice for making a grain or mixed feed concentrate available to pasture cattle. The desired daily consumption may be automatically fixed by adjusting the salt level.

Covered self-feeder containers with trough insert attachment, portable, and of 1,000- to 1,500-pound capacity are in rather common use. (Detailed plans for this type of feeder are available from the University of Arizona Agricultural Extension Service, Tucson.) Open troughs are less expensive though the feed may spoil and blow away.

A committee on animal nutrition of the National Research Council made this significant statement: "Data demonstrate that if a greater proportion of the concentrate feeds now available for beef cattle in the United States were used in the earlier stages of production to alleviate qualitative and quantitative deficiencies of range pasture, and wintering rations, these feeds would be utilized more effectively, continuous growth and development would be promoted, and a significantly greater tonnage of better-quality beef would result."

Arizona cattlemen, by demonstrating the effective use of salt for making nutritionally balanced feeds readily available to range stock, have made it possible to promote the continuous growth of young stock and achieve a more efficient use of range and pasture feed. THE END

Yuma Mesa Units To Be Opened for Entry

Twenty-seven public land farm units in the Yuma Mesa Division of the Gila project in Arizona south and east of Yuma, will be opened for settlement late in December 1951. This is the

second opening in this area. All applications will be considered as having been simultaneously filed provided they are received within 3 months of the opening date.

Veterans of the Spanish-American and World War I, and those who served at least 90 days in the Army, Navy, Marines, Coast Guard, or Air Force on or after September 20, 1940, and were honorably discharged have preference in filing for these units. Settlers must have had at least 2 years' farming experience and assets worth at least $6,000 in excess of liabilities. These assets must be cash, property readily convertible into cash, or livestock, farm machinery and equipment, which will be useful in the development and operation of a new irrigated farm.

The 27 farms consist of 4,051 acres and range in size from 116 acres to 160. The average size unit is approximately 150 acres. For information and applications write to the District Manager, Lower Colorado River District, Bureau of Reclamation, Yuma, Ariz. •

Columbia Basin Farms for Sale

Applications for purchase of 39 Columbia Basin project full-time farms located in Grant County, Wash., the central part of the project, will be available during December 1951. Prices range from $589.40 to $3,362.50 depending on the size of the farm and the class of land.

The farms which comprise 2,760.4 acres average 70.8 acres and range in size from 38 to 103 irrigable acres. Veterans of World War II, and all who have served in the Army, Navy, Marine Corps, Air Force, and Coast Guard since September 20, 1940, for a minimum period of 90 days and were honorably discharged, will be given preference in buying these farms. The closing date for filing applications is 90 days after the opening.

Applicants must have had at least 2 years farming experience and assets worth at least $4,500 in excess of liabilities. Assets must be cash, property readily convertible into cash, or property such as livestock, farm machinery and equipment which would be useful in the development and operation of a new irrigated farm. Inquiries, and requests for applications should be forwarded to the Columbia River Basin District Office, Bureau of Reclamation, P. O. Box 368, Ephrata, Wash. •

Relief for Middle Rio Grande Valley

Water users in the Middle Rio Grande Valley in New Mexico, who have been plagued by drought while at the same time salt cedar and other vegetation in the Rio Grande channel, plus evaporation from ponds and lagoons have been draining away an estimated 140,000 acre-feet of water each year, received a two-way relief program late in September. Secretary of the Interior Oscar L. Chapman announced a construction contract award for improving a 21-mile stretch of the Rio Grande, and placed the Government's seal of approval on an agreement with the Middle Rio Grande Conservancy District providing for repairs and extension of its irrigation and drainage system.

The double-barreled program is the first step in a comprehensive plan assigned to the Bureau of Reclamation by agreement of the Secretary of the Interior and the Secretary of the Army, to bring the Middle Rio Grande Valley up to its maximum production potential. The District's existing system was constructed to serve 118,000 acres of land, but only about 79,700 acres, including Indian lands, are irrigated at the present time. According to the plan an additional 5,200 acres will be placed under irrigation.

The Middle Rio Grande Conservancy District contracted to repay $18,000,000 to the Government within 40 years for repairing and extending its irrigation and drainage system, including the repair of El Vado Dam and reservoir. •

Andrew Weiss Dies

Andrew Weiss, internationally known consulting engineer and expert on irrigation, died Sunday, September 7, 1951, in Mexico City, his home since 1926. Burial services were held there Monday, and memorial services were held the following Saturday at Denver, Colo., under the sponsorship of the Colorado School of Mines Alumni Association.

Mr. Weiss, who was 84 at the time of his death, was former assistant director of reclamation economics, and joined the Reclamation Service in 1903. He served as assistant engineer and later as project manager on the North Platte project in Nebraska and Wyoming and the Salt River project in Arizona. In 1949 he was made an honorary member of the American Society of Civil Engineers (see page 56, March 1949 issue of the RECLAMATION ERA). •

CROPS

Strawberries Are Tops in Value

Farmers on the Salt River project in Arizona received almost $2,500 per acre for strawberries grown during 1950 according to the Bureau's latest crop report. The total crop on the project, weighing 3,500,000 pounds, was raised on 312 acres. The gross value amounted to $772,200. The per acre value of $2,475 was more than four times greater than apples, the next highest fruit crop grown on reclamation projects, which carried an average value of $539 per acre.

The Salt River berries are among the "first fruits" of the season, reaching markets in the United States far in advance of the regular strawberry crop, thus making them strictly noncompetitive.

In 1949 Salt River project farmers raised 2,016,000 pounds of strawberries, on 252 acres (60 acres less than in 1950) with a total value of $604,800 or $2,400 per acre. Despite the fact that the 1950 berries sold for 8 cents less than in 1949, the total per acre value received in 1950 was $75 more. Additional underground water installations, which provided better water supplies permitted the addition of 60 acres to cultivation. ●

The Era hereby extends an open invitation to Salt River project farmers to send in photos and more information about this successful crop. We believe our readers would be interested in knowing how they did it—what variety of plants was used, how they were irrigated, cultivated, harvested and marketed, plus any data regarding the capital investment necessary and an idea of the net profit resulting from such an undertaking.

We offer the same invitation to other farmers on reclamation projects to swap money-making ideas for irrigation farmers. Everyone likes to read success stories, and most everyone likes to tell his neighbors about a good crop, thriving livestock, farm improvements, and community activities. A free subscription to the Reclamation Era for 1 year is awarded to anyone whose material is published in the Bureau's official publication.

LETTERS

Sixth Army Likes "Short Cuts"

John T. Maletic, author of the current series of articles entitled, "Short Cuts to Weed Killing Calculations," received the following letter from the Headquarters of the Sixth Army, Presideo of San Francisco, Calif.

We are preparing a manual for the guidance and direction of the post engineers' weed-control program at Sixth Army installations. In this connection we have read with interest a portion of your article on "Short Cuts to Weed Killing Calculations." You are to be congratulated on your excellent presentation of this material.

The commanding general has directed me to request you to furnish us with a copy of the complete series and illustrations of this series of articles. Any other material that you have along the lines of weed killing operations that you feel would be of aid to us in preparing this manual will be welcomed.

Sincerely yours,

J. G. Dumbolten,
2d Lt. AGC,
Asst. Adj. General.

Have you a good idea on a short cut or labor-saving device to share with other water users on Reclamation projects? Send it in to your nearest Bureau of Reclamation office or to the Editor, Reclamation Era, Bureau of Reclamation, Washington 25, D. C. The writing does not have to be fancy. Just make certain you have the answers to Who, What, Where, When, Why, and How in your story. As for pictures, a rough sketch or snapshot would serve our purposes. Remember, this is the only official publication of the Bureau of Reclamation, the only periodical devoted entirely to the interests of water users on projects served with facilities made available by the Bureau. It is your magazine, and will be as good as you can make it. By helping others you will also help yourself. Send your item in today.

How To Do It

Here is a letter from W. G. Waggoner, of our Region 2 office in California. We agree wholeheartedly with his suggestion and hope our readers will flood us with their contributions for this new feature. We have asked for material like this continually, and occasionally receive gems like the one we worked out from Mr. Myer's letter and snapshot, which evolved as the article entitled, "Cover your Siphons" on page 277. Let's have more of the same. Start the ball rolling with an item from somebody on your project, and keep the short cuts or good ideas coming in.

I suggest that a section of the Era be titled along one of the following lines:

Short Cuts by Water Users.

Labor Saving Ideas Among the Water Users.

Good Ideas From the Water Users.

Passed Along by the Water Users, or

How To Do It Ideas From the Water Users.

The articles in this section should be short and to the point, illustrated by a photograph, and written with only the one purpose of imparting immediately usable information to the farmer—something he can do on his farm; a cheaper way to paint his barn; build a chicken coop; start his tractor in winter time; make a new door catch; a dispensing hog feeder; stretch wire fence, etc., written in the style of the Popular Science magazines.

I remember when I was a kid on the farm our entire library consisted of the family Bible, the weekly newspaper, Popular Mechanics, and the Sears, Roebuck catalog. My mother read the Bible, the newspaper went to start fires, Popular Mechanics was worn dog-eared each month looking for ideas we could apply on the farm, and we all used the catalog. The popular science magazines mostly owe their popularity to the fact that they are a kind of national suggestion box, containing down-to-earth usable ideas.

The best and most logical source for this article material is the farmer on Bureau operating projects. As an occupational group I believe farmers are the most resourceful and inventive. Their activities are so varied, they are usually remote to a ready source of specialized skills, that they must continually improvise practical answers to their problems.

As an operating means for initiating and sustaining this water users section of Reclamation Era, one project could be covered for each issue. Bureau per-

sonnel with the assistance of water user's officials could ferret out the short cuts used on the particular project featured and write them up for the ERA. With this added feature I think we could have a publication of vast interest to the water users.

FOREIGN ACTIVITIES

The Bureau of Reclamation's assistance is constantly being sought by many foreign nations whose problems in dealing with irrigation, power, potential dam sites, water resources, etc., are those with which the Bureau is familiar and uniquely capable of resolving. These requests for technical assistance reach the Bureau through the Department of State, the Economic Cooperation Administration, the Department of the Army, the Department of the Navy, and other Federal agencies.

The technical cooperation activities of the Bureau involve 18 reclamation technicians in 13 foreign countries. The foreign training program includes 30 trainees from 11 countries, the number of accredited foreign visitors average 30 per month and the publications are being sent abroad at the rate of 6,000 per year. This assistance is performed without any cost to the Bureau. Here are some of the Bureau's current foreign activities:

CHILE.—Reclamation Commissioner Michael W. Straus is delivering a series of lectures on reclamation administrative procedures in Santiago under the auspices of the Latin American Training Center of the Food and Agricultural Organization of the United Nations. The purpose of this meeting is to discuss plans and projects for agricultural and hydroelectric development in Latin America.

ECUADOR.—William H. Farmer, irrigation engineer, has been assigned to investigate and study the feasibility of irrigation developments on the Santa Elena Peninsula in cooperation with the Ministry of Public Works.

FORMOSA.—T. R. Smith is making a survey of the over-all water conservation facilities in terms of present and future needs for the improvement, alteration and expansion of present facilities, and will recommend what should be done and how it should be done.

GREECE.—Harold E. Miller, hydraulic engineer, is advising on the construction of two multiple purpose projects involving flood control, irrigation, and power.

INDIA.—Hugo Marek, Jr., is acting as technical adviser to that Government on foundation explorations and treatment at Indian dam sites, particularly construction of the Kakrapar Dam in the State of Bombay and the Hirakud Dam in the State of Orissa.

LIBERIA.—Robert R. Williams is working directly in the Water Control Division of the Department of Public Works, planning and directing investigations of hydroelectric power potentialities, including preliminary investigations of power potentialities.

MALAYA.—Edward R. Dexter, civil engineer, and William H. Irwin, assistant chief geologist, are advising on the construction of an impounding dam at the Klang Gates near Kuala Lumpur, capital of the Federation of Malaya. The peculiar problems present at the Klang Gates are similar to those of a great number of American dams which have been built on more or less fissured bedrock.

SAUDI ARABIA.—C. William Burningham and Thomas R. Smallwood are advising that Government on hydrology, basic surveys for land and water development, the designing of irrigation systems, including storage dams, weirs, and other diversion structures, waterspreading works for ground water storage, pumping plants and community distribution systems.

THAILAND.—August L. Ahlf and Mauric E. Day are advising that Government on canal designs for the Chao Phya and other irrigation projects.

A few of the qualified engineers from foreign countries who are taking in-service training at the Denver laboratories are: Michel Guessard, FRANCE; Barry Rydz and E. Drummond Taylor, GREAT BRITAIN; Yadurai Kaul, INDIA; Tahsin Bakr, Abdul Kaddou, and Najib Kassab, IRAQ; Abba Tor, ISRAEL; Giuseppe Barbero, ITALY; Mohammed Badruddin, PAKISTAN; Dennis Standish-White, SOUTHERN RHODESIA; Sathien Bhadrasiri, Chien Bhumisawasdi, Ananda Indrathorngmon, M. L. P. Malakul, Udom Panyaphol, Chalaw Hunranaphan, Om Dibbabadya, Tamon Kandhasingha, Boonthai Otaganonta, Bhochana Panyadhibya, Bachong Pisalbutra, Amphan Poonagunta, Udom Rakchanya, Sara Subharngkasen, Vira Suttipongse, THAILAND; M. S. Canakin, Ali G. Mutdogan, Kemal Noyan, Osman C. Ugur, TURKEY; and Rafael de Los Rios, Jóse R. Grillet, Manual Lanz, Alejandro Rengel, VENEZUELA.

RELEASES

Missouri River Basin Topographic Maps Available

Several new topographic maps, essential to the progressive development of the Missouri River Basin, have been recently published by the Geological Survey, presenting a symbolized picture of the natural and man-made features existing upon the land surface. They portray drainage and the general configuration of the land in any particular area, and delineate the roads, railroads, dwellings, lakes, rivers and streams, etc. The latest maps in the series, needed as the background for planning the Department's Missouri River Basin program, and prepared to meet the urgent requirements of the two construction agencies, the Bureau of Reclamation and the Corps of Engineers, are as follows: Hudson, Colo.; Milliken, Colo.; Cascade, Mont.; Norris, Mont.; Cottonwood Falls, Wyo.; the Reefs, Wyo.; Guernsey Reservoir, Wyo.; Mexican Pass SE., Wyo.; Moon Lake, Nebr.; Turpin Lake, Nebr.; Wolf Lake, Nebr.; Camp Grafton, N. Dak.; Harvey, N. Dak.; Oberon, N. Dak.; Crow Hill, N. Dak.; Westhope, N. Dak.; Big Falls, Nebr.; Brownlee, Nebr.; Bull Lake, Nebr.; Long Lake, Nebr.; Grand Harbor, N. Dak.; Polo, S. Dak.; Rezac Lake, S. Dak.; Rice Lake, S. Dak.; and Grantville, Kans.

The maps vary in size and price. Inquiries should be sent to the Director, Geologic Survey, United States Department of the Interior, Washington 25, D. C.

NOTES FOR CONTRACTORS

Contracts Awarded During October 1951

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DS-3451	Colorado-Big Thompson, Colo.	Oct. 4	2 5,000 horsepower at 300 revolutions per minute vertical-shaft synchronous motors for Willow Creek pumping plant.	Electric Products Co., Cleveland, Ohio.	$140,483
DS-3473	Boise, Idaho	Oct. 11	2 switchgear assemblies for Anderson Ranch power plant, item 1.	Westinghouse Electric Corp., Denver, Colo.	17,530
DS-3480	Central Valley, Calif.	Oct. 19	9 motor control and 9 distribution switchboards, 2 motor starters, and 1 distribution cabinet for pumping plants S-4 to S-10, inclusive, and S-12, S-13, and S-14, in laterals 124.5E, 127.7E, and 130.4E, Unit 3, Southern San Joaquin Municipal Utility District, Friant-Kern Canal distribution system, schedules 1 and 2.	General Electric Supply Corp., Denver, Colo.	83,160
DC-3482	Cachuma, Calif.	Oct. 29	Construction of Glen Anne Dam, pts. A and B	L. A. and R. S. Crow, El Monte, Calif.	733,740
DS-3492	Boise, Idaho	Oct. 10	One 2,000-kilovolt-ampere transformer with 3 23,000-volt lightning arresters for Prairie Power Cooperative substation, schedule 1.	Erie Electric Co., Inc., Buffalo, N. Y.	10,545
DS-3511	Central Valley, Calif.	Oct. 11	3 15-foot 6-inch diameter steel penstocks for Folsom power plant.	Southwest Welding & Manufacturing Co., Alhambra, Calif.	417,500
DS-3512	Colorado-Big Thompson, Colo.	Oct. 5	1 combination welded-plate-steel discharge pipe for pump discharge line for Willow Creek pumping plant.	Eaton Metal Products Co., Denver, Colo.	13,000
DS-3513	do	Oct. 12	3 14,000-volt circuit breakers, 6 40-kilovolt-amperes current-limiting reactors, and 6 potential transformers for Flatiron power and pumping plant switchyard and Pole Hill power plant switchyard, schedules 1, 3, 4, and 5.	General Electric Co., Denver, Colo.	36,233
DC-3514	Columbia Basin, Wash.	Oct. 19	Construction of Babcock pumping plant and lateral W35.9, area W-8, West canal laterals.	Collins Concrete & Steel Pipe Co., Portland, Oreg.	795,387
DS-3519	Missouri River Basin, Mont.	Oct. 16	5 115,000-volt circuit breakers for Canyon Ferry switchyard, schedule 1.	General Electric Co., Denver, Colo.	122,370
DS-3519	do	do	4 115,000-volt selector-type switches and two 115,000-volt disconnecting switches for Canyon Ferry switchyard, schedule 2.	USCO Power Equipment Corp., Birmingham, Ala.	26,148
DS-3519	do	do	7 current and 4 potential transformers for Canyon Ferry switchyard, schedule 3.	Westinghouse Electric Corp., Denver, Colo.	30,611
DC-3524	Missouri River Basin, Nebr.-Kans.	Oct. 31	Construction of Franklin South Side pumping plant, canal, laterals, sublaterals, and drains.	Rentlor Co., Inc., Grand Island, Nebr.	262,155
DC-3528	Columbia Basin, Wash.	Oct. 25	Construction of earthwork, lateral lining, pipe lines, and structures for Area P-1 laterals and sublaterals, Potholes East canal laterals, schedule 1.	Long Construction Co., Inc., Billings, Mont.	1,598,362
DS-3529	do	Oct. 19	2 1,500-kilovolt-ampere, 1 500-kilovolt-ampere, and 2 300-kilovolt-ampere transformers for Lower and Upper Scooteney, Lower Saddle Gap, Upper Scooteney Relift, and PE-17 pumping plant switchyards, schedules 1, 2, and 3.	Gough Industries, Inc., Los Angeles, Calif.	41,848
DC-3530	do	Oct. 2	Construction of earthwork, pipe lines, and structures for area W-5 laterals, sublaterals, wasteways, and drains, West canal laterals and West canal protective works, schedule 1.	Cherf Bros. Construction Co. and Sandkay Contractors, Inc., Ephrata, Wash.	1,297,351
DS-3531	Cachuma, Calif.	Oct. 11	1 36-inch diameter tube valve with floor-stand control for regulating works on Tecolote tunnel.	Northwest Marine Iron Works, Portland, Oreg.	12,709
DC-3538	Columbia Basin, Wash.	Oct. 24	Construction of earthwork, pipe lines, and structures for Area P-2 laterals, sublaterals, and wasteways, Potholes East canal.	Intermountain Plumbing Co., Inc., and Henry L. Horn, Moses Lake, Wash.	237,439
DS-3539	Hungry Horse, Mont.	Oct. 19	2 control valves, 1 control stand, and 1 lot of control connections for spillway ring gate at Hungry Horse Dam.	Northwest Marine Iron Works, Portland, Oreg.	15,749
117C-116	Columbia Basin, Wash.	Oct. 24	Drilling water supply wells at O&M sites for areas E-2, E-3, P-1, and P-2 ditchriders residences, schedules 1, 4, 6, and 7.	Frank L. Zimmerman, Moses Lake, Wash.	20,516
117C-116	do	Oct. 23	Drilling water supply wells at O&M sites for areas E-2, E-3, P-1, and P-2 ditchriders residences, schedules 2, 3, and 5.	Ralph Cassell, Yakima, Wash.	10,852
117C-116	do	Oct. 19	Drilling water supply wells at O&M sites for areas E-2, E-3, P-1, and P-2 ditchriders residences, schedule 8.	Courtney Bach, Union Gap, Wash.	13,920
100C-135	Lewiston Orchards, Idaho	Oct. 16	Construction of operator's house at water treatment plant.	Taschereau Construction Co., Spokane, Wash.	14,013
117C-118	Columbia Basin, Wash.	Oct. 11	Constructing timber bridge at West Canal, station 1807+77.29.	Allied Construction Co., Ephrata, Wash.	16,840
117C-122	do	Oct. 24	Gaging stations, Main, East Low, Potholes, West Canals, Winchester, Rocky Coulee, and Weber wasteways.	Harold Kaeser, Seattle, Wash.	44,606
200C-176	Central Valley, Calif.	Oct. 26	Line maintenance building at Orland, Calif.	Modern Building Co., Chico, Calif.	22,098
300C-29	Davis Dam, Ariz.	Oct. 31	Construction of Cochise substation	Hufford & Kyger Construction Co., Kansas City, Mo.	69,795
601C-18	Riverton, Wyo.	Oct. 10	Access roads and bridges across Five Mile and Muddy Creeks	Sharrock and Pursel, Casper, Wyo.	27,599
617C-22	do	Oct. 23	Asphaltic lining for Wyoming Canal and laterals	Studor Construction Co., Billings, Mont.	451,971
617C-23	do	Oct. 31	Application of asphalt membrane lining, Pilot canal and laterals.	Blacktop Construction Co., Billings, Mont.	149,740

Construction and Materials for Which Bids Will Be Requested by February 1952

Project	Description of work or material
Boulder Canyon, Ariz.-Calif.	Construction of 5.4 miles of 12- to 42-inch diameter concrete pipelines for unit 9, part II of the Coachella Valley distribution system near Coachella, Calif., All-American canal system.
Buffalo Rapids, Mont.	Additions and improvements to pumping plants and canal structures for Shirley and Terry units and channel relocation and wasteway structures for Fallon unit.
Cachuma, Calif.	Construction of 18- by 65-foot Lauro chlorination and control house near Santa Barbara, Calif. Installation of about 15 36-inch diameter valves and 1,500 feet of 54-inch diameter steel pipe, venturi meters, and other equipment for chlorination of 55 cubic feet per second of water for domestic purposes.
Do.	Construction of 16 miles of concrete pipe conduit varying in size from 36- to 27-inch diameter, and 3 control stations, part of the Carpinteria section of South Coast conduit near Santa Barbara, Calif.
Central Valley, Calif.	Construction of ditch riders' houses at Newman and San Luis wasteways on Delta-Mendoata Canal near Newman, Calif.
Central Valley, Calif.	Construction of 160,000-kilowatt Folsom power plant near Folsom, Calif. This semioutdoor type plant will require construction of a reinforced concrete structure about 120 by 240 feet and 107 feet high and installation of 3 74,000-horsepower turbines, a 300-ton gantry crane, and other equipment. 3 15.5-foot diameter, 200-foot long Government-furnished pentstocks are to be embedded in concrete-lined rock tunnels. Additional excavation required for the power plant and tailrace channel wil be about 85 percent in rock.
Do.	Construction of 43 miles of pipelines for Exeter irrigation district on the Friant-Kern Canal distribution system, near Exeter, Calif. Contractor is to furnish the 12- to 42-inch diameter pipe with heads up to 75 feet. Work also includes construction of monolithic concrete mess screen and pumping plant structures, installation of moss screens, pumping units, valves, slide and flap gates, and furnishing and installing electrical controls.

U. S. GOVERNMENT PRINTING OFFICE: 1951

Construction and Materials for Which Bids Will Be Requested by February 1952—Continued

Project	Description of work or material
ntral Valley, Calif.	3 230-kilovolt 800-ampere and 1 69-kilovolt 1,200-ampere outdoor power circuit breakers and 7 230-kilovolt and 5 69-kilovolt disconnecting switches for Folsom switchyard.
Do	3 horizontal-shaft centrifugal-type motor-driven pumping units and 6 vertical-shaft propeller-type motor-driven pumping units of 2 to 4 cubic feet per second capacities for pumping plants E1 to E5; and 3 vertical-shaft turbine-type moss screen pumps, each 360 gallons per minute, for Exeter irrigation district No. 2, Friant-Kern canal distribution systems.
lorado-Big Thompson, Colo.	Installation of 2 48-000-horsepower turbines, governors, pump turbine, and a 13-000-horsepower generator-motor unit, transformers, circuit breakers, and switchyard equipment, and completion of building interior for the 80-000 kilovolt-ampere Flatiron power plant; and installation of 1 47,500-horsepower turbine, governor, transformers, circuit breakers, and switchyard equipment, and completion of building interior for the 35-000-kilovolt-ampere Pole Hill power plant.
lumbia Basin, Wash.	Completion of electrical installations in industrial area, machine shop, and warehouses A and B, including electrical wiring for underground distribution system in industrial area and removing existing overhead distribution system; removal of existing heating plant; installation of substation for caisson drydock and installation of feeder canal gaging equipment, at Grand Coulee Dam.
Do	Placing terrazzo in Grand Coulee right power plant, pumping plant, and machine shop.
Do	Construction of streets, sidewalks and curbs; sewer and water lines: grading lots and parking areas; paving streets; installation of street lighting, and removal of miscellaneous buildings in town of Coulee Dam, Wash.
Do	Construction of 20 miles of unlined laterals and wasteways of 180 to 2 cubic feet per second capacities, to irrigate about 6,000 acres in lateral area P-3 on Potholes East canal, northwest of Mesa, Wash.
Do	Construction of 6 miles of 30 cubic feet per second capacity lined channel, 6 miles of 60 cubic feet per second capacity unlined channel, and 9 culverts for interception and conveyance of excess ground water in the vicinity of Soap Lake, Wash.
Do	Construction of 48 miles of unlined laterals and wasteways of 119 to 2 cubic feet per second capacities to irrigate about 18,000 acres in lateral area E-4 on East Low canal, north of Warden, Wash.
Davis Dam, Ariz-Nev.	Erecting steel structures and installing electrical equipment for 13.8-kilovolt installation at Tucson substation.
Do	Erecting steel structures and installation of electrical equipment for 69-kilovolt switchyard and transformer circuits at Davis Dam, Ariz.
Deschutes, Oreg.	Lining North Unit canal with pneumatically applied mortar between Bend, Oreg., and 24 miles northeast of Bend.
Eklutna, Alaska	Steel penstock for Eklutna power plant, 1,400 feet in length, and 72, 78, and 84 inches in diameter.
Do	2 vertical, gate-shaft type, 50,000 foot-pound capacity governors for 24,000-horsepower hydraulic turbines at Eklutna power plant.
Fort Peck, Mont.-N. Dak.	Construction of 115/12.47-kilovolt Dawson substation at Glendive, Mont., involving erecting steel structures, installing major electrical equipment, and furnishing and installing all other equipment, and construction of operation and maintenance and service buildings.
Gila, Ariz.	Construction of 28 miles of unreinforced concrete-lined Mohawk laterals and sublaterals of 120 to 15 cubic feet per second capacities, and appurtenant reinforced concrete structures, and removal of existing timber and concrete structures, for unit 1 near Roll, Ariz.
Kendrick, Wyo.	Installation of armor rods and vibration dampers and changing overhead ground wire connections on 22 miles of 115-kilovolt transmission line between Gering and Alliance, Nebr., and Gering and Casper, Wyo.
Middle Rio Grande, N. Mex.	Construction of channel headquarter buildings at San Marcial, N. Mex., about 20 miles south of San Antonio, N. Mex. Included are a 3-bedroom, 34- by 42-foot concrete block dwelling, a 40- by 100-foot office, warehouse, and shop building of prefabricated steel, and 12- by 18-foot prefabricated steel storage building, a 10- by 12-foot concrete block pump house, and utilities.
Do	Construction of 17 miles of Rio Grande River drainage and conveyance channel and levee from San Marcial, N. Mex., to channel headworks.
Missouri River Basin, Nebr.	Removing a portion of consumers' public power district diversion dam, removing 2 bridges, and excavating for extension of Lost Creek channel at Superior, Nebr.
Missouri River Basin, Wyo.	Supervisory control and telemetering equipment for controlling Lovell and Thermopolis substations from Boysen power plant.
Shoshone, Wyo.	Lining 3 miles of Heart Mountain Canal.

United States Department of the Interior

Oscar L. Chapman, Secretary

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Washington Office: United States Department of the Interior, Bureau of Reclamation, Washington 25, D. C.

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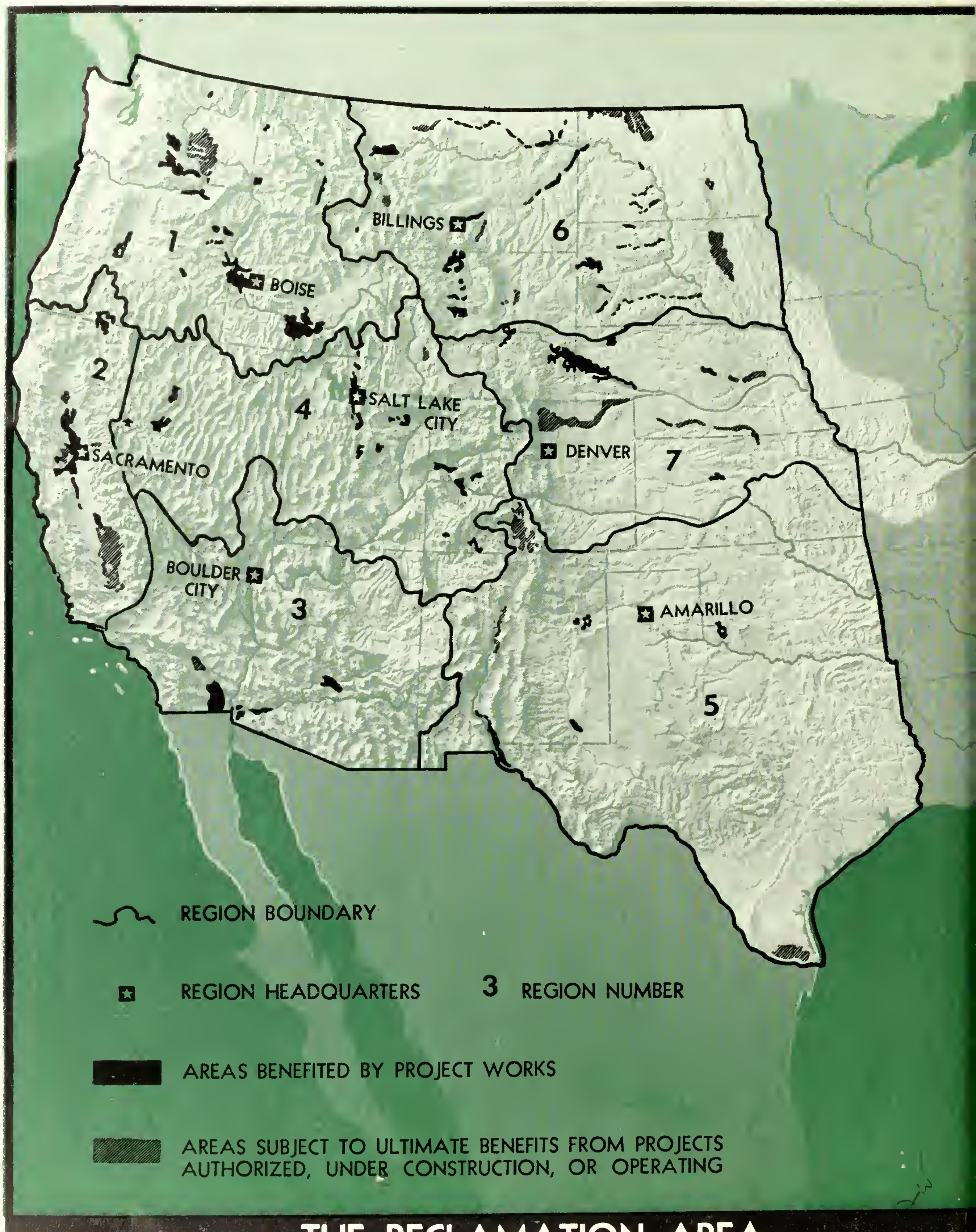

THE RECLAMATION AREA